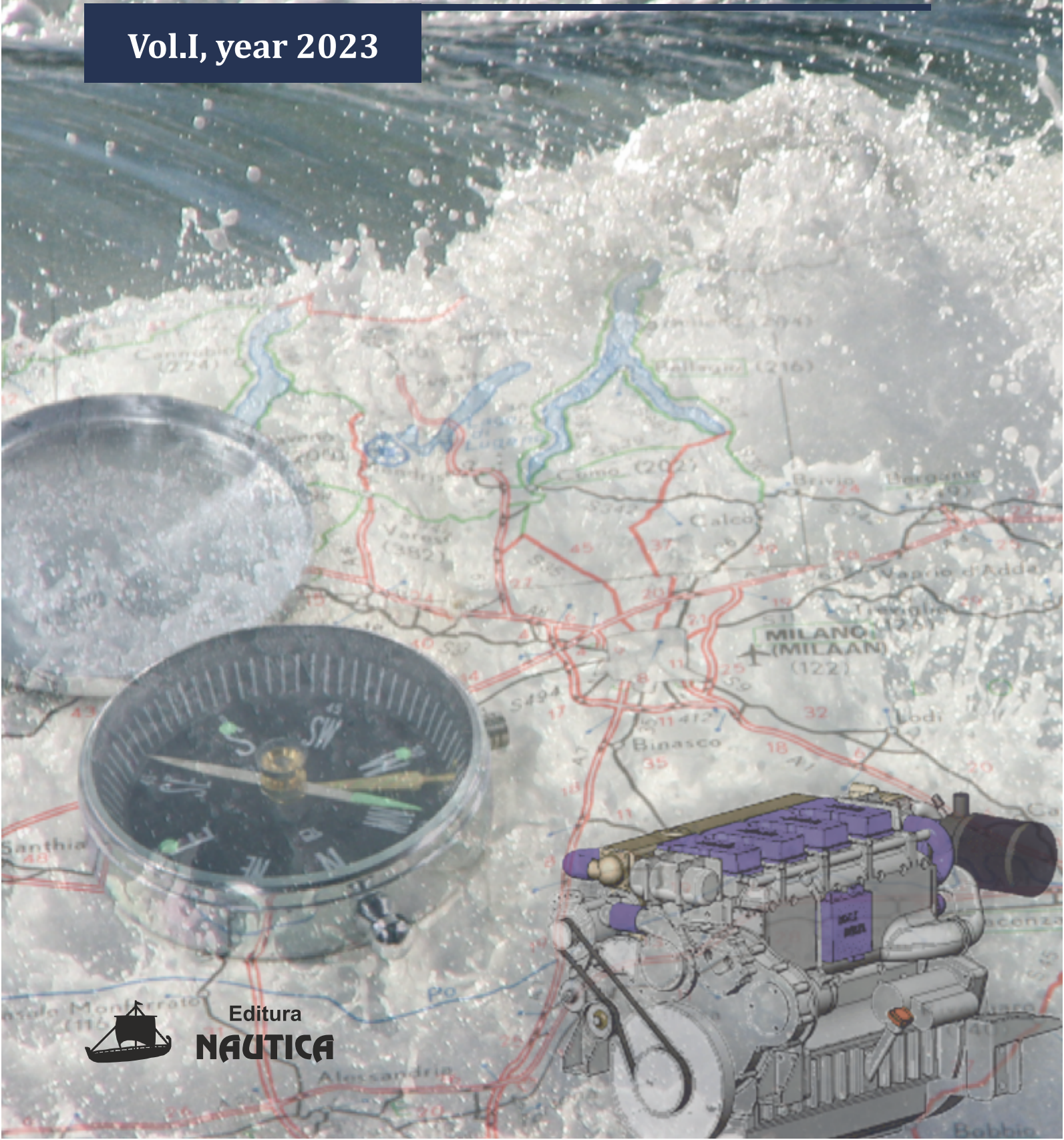


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THE ROLE OF CAREER COUNSELORS IN VOCATIONAL EDUCATION

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Abstract: Passing from school to the labour market requires support, advice, and guidance. The rapid advancement of technology in the maritime industry, the wide range of duties, and ever-changing job placement from ashore to remote sites or on board vessels, put many treats on the future employees. This article describes how career counselling is integrated into the process of supporting VET learners in making decisions about future careers in three European countries and how this process is perceived by learners.

The research comprised a literature review to reveal the approach with regard to career counselling and analysis of data collected with a survey questionnaire. The 88 responses emphasized learners' views regarding the career counsellor's actual role and provided an understanding of their expectations for making the transition toward the labour market. The questions addressed groups of people that decided to continue their studies and get a job and those undecided. Participants explained the motivator factors for making the career choice, the main sources of career information, and their expectations from the future job. This article explores the extent to which the professionals and counsellors would contribute to making the decisions and the types of interaction that are expected to produce positive results and engagement.

The results indicate that teachers and parents are currently contributing to making the final career decision. Even though, the input of professionals is highly expected by all groups of participants. Respondents emphasized that challenges, dynamism in the workplace as well as the variety of tasks are those factors that would make them stay in a job. The authors concluded that to be effective, the career counselling of young learners needs to be enriched with job-specific insights provided by professionals. The research conclusions draw up the VET learners' main expectations that can be used to guide further career counselling activities.

Keywords: blue career, counsellor, guidance, mentor, vocational education.

1. INTRODUCTION

The old ideal of retiring after many years with one company and taking home a pension is passing into history. According to a 2019 Bureau of Labour Statistics survey of baby boomers, the average number of jobs in a lifetime is 12 (BLS, 2019). The worker's age impacts the number of jobs they held in various lifetimes. Workers held an average of 5.7 jobs during the six years when they were 18 to 24 years old, declining with age in such a way as many workers aged 45+ held an average of 1.9 jobs (Doyle, 2020).

Undoubtedly, appropriate guidance can help young people to understand their learning needs and career preferences based on their strengths and talents. For this reason, in the early 20th century, career guidance and counselling started to emerge in several countries around the world (Gysbers, 2008). The conventional approach to career counselling relies on the interpretation of test results and the suggestion of a few specialities by a career counsellor. The studies demonstrate that a

successful learning path might be aided by receiving enough information about the profession (CEDEFOP, 2021).

The transition from using tests in career counselling to help people construct future careers depends on career counsellors' abilities to make them describe who they really are by articulating their career lives in words (Hartung, 2013).

Nevertheless, the traditional style of career counselling based on the interpretation of tests and recommendations by career counsellors still prevails in several countries (Maree J., 2020).

Modern approaches in career counselling focus on helping people to construct their careers. Career construction counselling entails an interpersonal process of helping people design their lives through work and careers (Savickas, 2011).

Providing career construction counselling to people wanted to start a career in the shipping industry is challenging. There is a common complaint from shipping companies, that the new maritime entrants are



just not the right material for shipping. This is also borne out by the high attrition rate – the number of fresh entrants getting disillusioned about maritime careers, and eventually quitting shipping. The reason we are not able to retain people in the shipping industry is not the fault of the job itself, but more in the faulty method and manner of selection of learners for various maritime careers. A properly planned vocational guidance can help a lot to resolve this issue.

Prospective students, who seek to make their careers in the Merchant Navy, must have the necessary skill sets, to survive in the marketplace, over the long term. Today, the Maritime industry is going through a sea change, just as the rest of the industries worldwide. There is a new economic order, defined by new technology and globalization. Properly managed vocational guidance centres at least in the Metro cities, are vital, to face this challenge.

Working in the shipping industry can be rewarding because wages earned are normally above similar professions ashore. As in almost every area in life, there are two sides to the coin in the maritime. Even though the advantages outweigh for many people, career advisors recommend to those planning to work in this industry initial preparation for the challenges (Zeymarine, 2020).

Opportunities in maritime are both at sea, in ports or ashore in supporting maritime activity. At sea, the earnings and leave balance offer better terms and conditions than nearly all other sectors. Careers ashore in maritime are diverse. Transferrable maritime skill sets are in demand so all variety within the sector will attract a salary and terms and premium conditions. The greatest challenge for any maritime areas ashore is attracting maritime skill sets so service resettlement candidates are a desirable maritime commodity. (CTP, 2020)

Using interviews and drawings of scientists has proven some controversial aspects considering the ability of a student to gain a set of knowledge using different methods. Related research with school students has shown that their occupational preferences and career aspirations are strongly linked to their images of careers (Gottfredson 1981). This image is usually constructed by someone who is well-prepared to give advice and to contour the learners' base knowledge – such as a good teacher, or a mentor.

Being a mentor for someone eager to learn is something that gravitated around humanity for a long period now. Starting from the relationship established between Medici and Michelangelo or Freud and Jung, the concept of “mentor” and “student” had developed and acquired the words development, growth, evolution, realization, and knowledge.

The mentor plays an important role in initiating the process of career decision-making and guiding young people toward success. The mentor's performance is directly proportional to the learners' collaboration. It has weak effects on the productivity of non-collaborating learners, while for those who collaborate with their

mentor, there is a positive effect (Long & McGinnis, 1985).

The one who is guiding their students through the process of learning continues to influence the career with a positive effect on the mentor's performance on academic placement, an effect not found for non-collaborators.

Having a career in the blue industry is challenging and exciting and it provides a wide range of sectors from which students can choose. Longer term, careers in the global maritime industry provide seafarers with a plethora of opportunities and the education, training, and experience for a lifetime of gratifying challenges, whether at sea or onshore.

The blue economy includes all economic activities related to oceans, seas, and coasts. It covers a wide range of interlinked established sectors (e.g. shipping, offshore oil & gas, coastal tourism) and emerging sectors (e.g. offshore renewables, biotechnology). The blue economy is a priority of the European Union because it represents 3.5 million jobs with 174 billion Euro gross value added (EC, 2021). As for all industries, the blue economy sectors operate in cycles, with periods of highs and lows. During periods of low, people can hardly find a job. However, the sector cycles do not overlap, meaning that when the shipping is low, the offshore oil and gas may be high; as a result, there may be more job offers in oil and gas compared to shipping.

Career choice is a significant step in individual life and this study revealed the expectation of VET learners in terms of guidance in their careers. Taking into consideration the niche of the blue industry and the high level of remuneration expected in a short time, the authors decided to research to identify the motivator factor in choosing a career. Nevertheless, the career decision-making process is very complex and takes into consideration various internal and external factors.

The below research was conducted in three European countries to emphasize how the cultural background and education systems may impact the career decision process made by VET learners.

2. RESEARCH METHODOLOGY

In order to address the right persons, the authors selected the relevant respondents as VET learners, which may have an interest in choosing a profession in the blue industry. Each participant received job cards presenting various careers from the blue industry. All career cards have the same structure presenting the general description of the job, the range of annual salary, the working program, the type of education and the competencies required for starting and getting a promotion in that career, opportunities for cross-sectoral mobility as well as links to relevant job platforms.

After studying the job cards, respondents were asked to answer a nine-question survey. The first two were filtering questions willing to further analyse if gender or nationalities lead to different expectations regarding

career guidance in the blue economy. The next seven questions were designed to understand the expectations of the next generation of employees, as well as the motivator factors for making the career choice. An open question was included to ensure space for written responses. The questions were included in Google form and the respondents received it together with the job cards.

The online survey was available for four months and it closed with 88 responses. The responses were analysed and the findings are presented in the next section. The research envisaged qualitative analysis and the results are limited to the country area and VET schools from which the responses were collected.

The responses were collected from 43 VET learners from Romania, 24 from Turkey, and 21 from Spain with the below distribution (Figure 1), aged from 17 to 27.

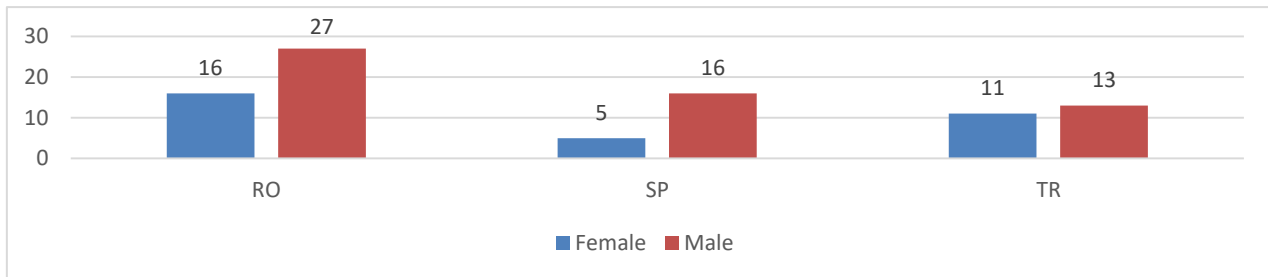


Figure 1 Distribution of respondents per country

3. MAIN FINDINGS

The first question addressed VET learners committed to choosing their future careers. More than half of the respondents confirmed that once they graduate from VET school, they would continue their

studies at university. The responses analyzed in a country context, reveal that only 10% of the VET graduates from Spain would continue at the university and only 2% of graduates from Romania would choose to join a course to become specialized in a certain field (Figure 2).

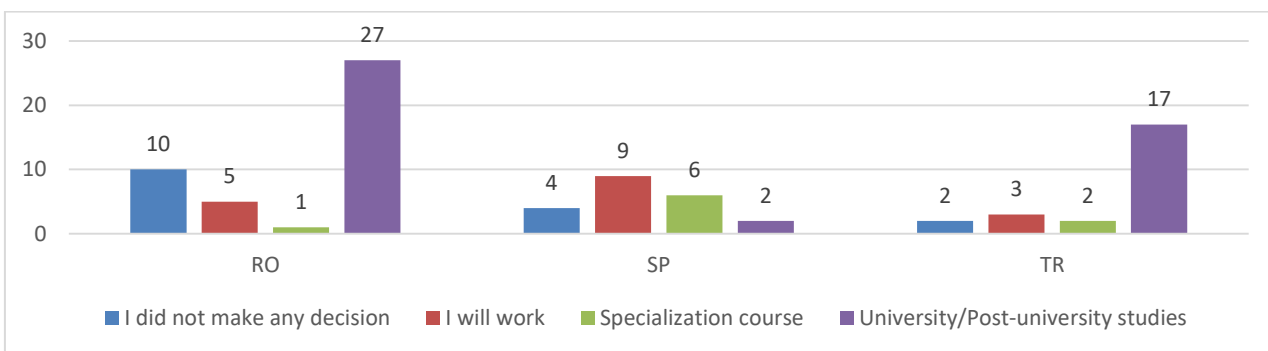


Figure 2 Next step after the VET school

Respondents were asked to indicate who is the person that provides them with information about the career to choose. Most of the respondents with a slightly equal percentage confirmed that parents and teachers guide them regarding their career prospects. Only 13% of VET learners are guided by a career guidance counsellor. About a quarter of the respondents confirmed that they are not receiving any information about the

career. Regarding career guidance in the national context, it is a strong influence of Romanian parents in the career decision-making process, while in Turkey the teachers are those guiding the VET learners to a greater extent (Figure 3).

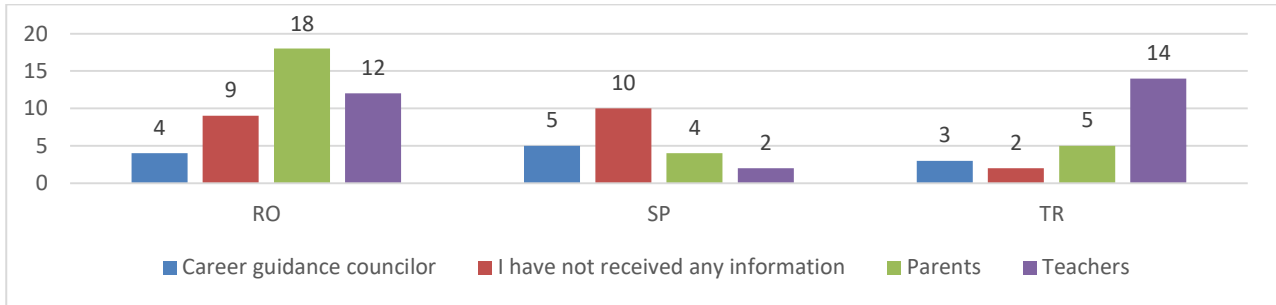


Figure 3 VET learners guidance

Willing to understand what the main channels are providing VET learners information for making the career decision, it resulted that more than 80% of respondents are being influenced by talks on career

prospects or their interest in a particular profession. Only a few respondents admitted that they will base the decision on the information received from the career guidance counsellor or mass media (Figure 4).

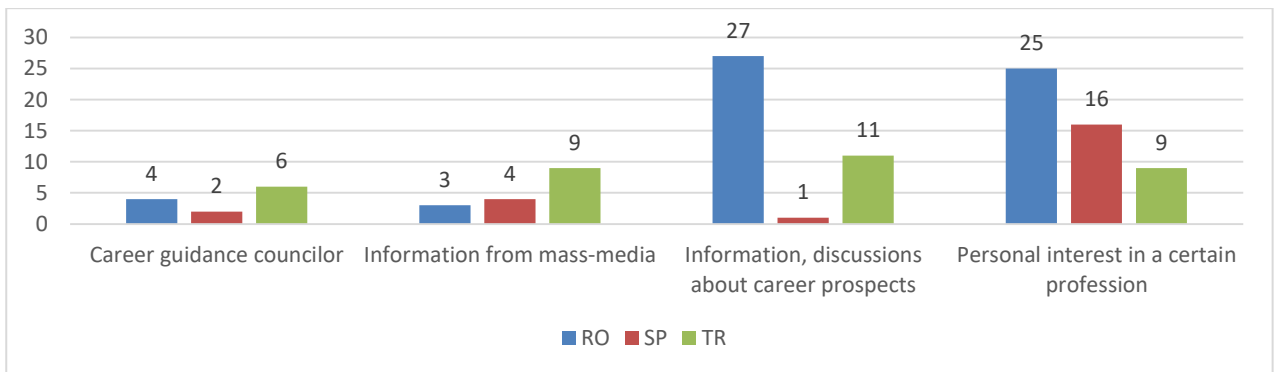


Figure 4 Channels of information for career decision

The next question revealed the expectations of the VET graduates from their job. Most of the respondents choose the monthly income, as the dominant factor that influences them in choosing their future profession. Only a few responses showed interest in reaching positions that offer career advancement. More than 30% prefer to choose a career that offers more job opportunities.

Analyzed in a national context, it resulted that the VET graduates from Spain were not interested in fast career advancement and that none of the respondents from Turkey was interested in having enough free time for other things (Figure 5).

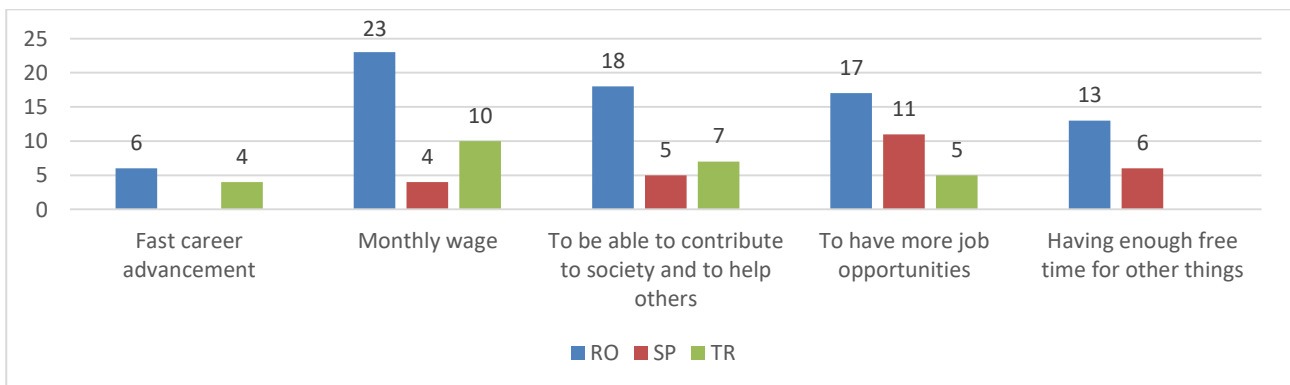


Figure 5 Expectations from the job

The next question addressed the job cards presenting the careers in the blue industry. Upon reading the job cards, the respondents were requested to express opinions about the completeness or missing information. The blue career job cards in the blue economy included job descriptions, medium salary, work schedule, the education and skills needed for career advancement, opportunities to work in related sectors, and links to relevant professional associations. 98% of the respondents consider that the information is sufficient for making an informed decision. Those considering that

some more information is needed were invited to indicate what they would like to find in a job card. The responses were mainly related to the monthly income.

The last question of the survey invited the respondents to express their thoughts about their willingness to gather and find out more about blue careers. By far, most respondents confirmed that they would like to meet professionals to discuss future careers. In the national context, the respondents from Turkey showed a great interest to receive information from their VET teachers (Figure 6).

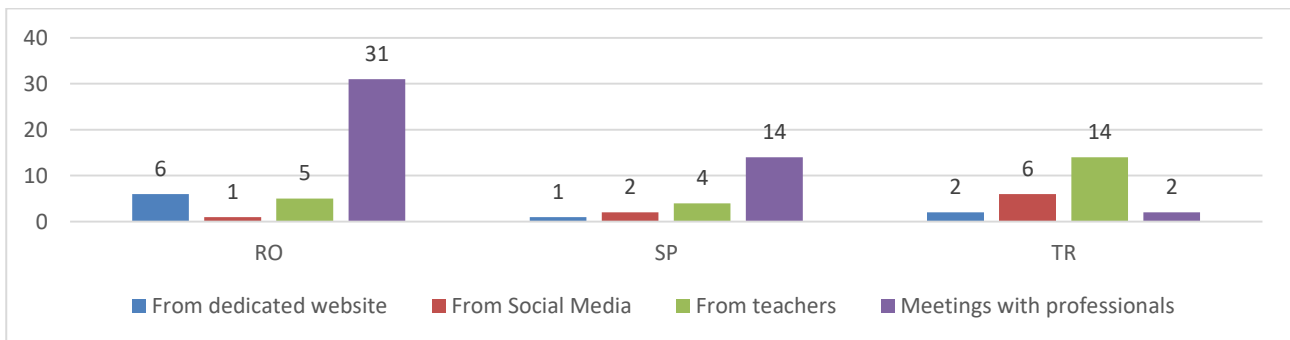


Figure 6 Preference to find more about blue careers

4. ANALYSIS OF THE RESPONSES

The research aimed at understanding the preferences and expectations of VET learners about the support needed for making an informed decision about their future careers. From this perspective, the study analyzed who and in which direction they are guided, the job expectations as opposed to the type of educational background and gender, and a very important aspect for increasing the quality and relevance of career

counselling: the preferred sources of information that can help VET learners in making the decision.

The results showed that the majority of those guided by parents and teachers (64%) are willing to follow university or post-university studies. About half of those respondents that did not receive any information about the career, said that they did not decide yet about the following steps. The other half would prefer to work, to follow university or post-university studies (Figure 7).

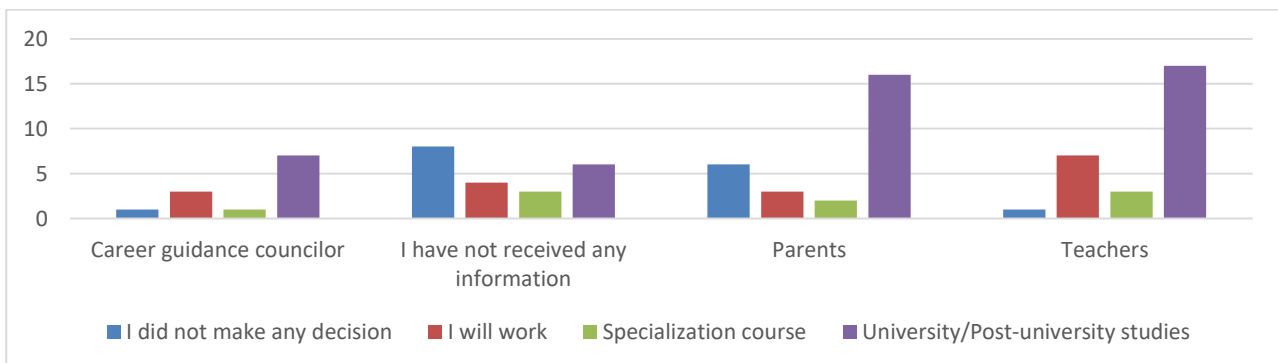


Figure 7 Decision and guiding

Among the expectation, various intrinsic and extrinsic factors are contributing to their choice. Among these: to be interesting, varied, with social prestige and admired by others as well as salary. Those respondents that mentioned that they will work after graduation,

prefer jobs that are dynamic, offer work stability, and the possibility to learn. None of those that expressed their willingness to work immediately after graduation, they do not expect admiration, prestige, or creativity. Those respondents that would like to continue their studies are

equally motivated by jobs that are dynamic, by salary, and careers that allow continuous learning. Less interest

was shown in social prestige and admiration of others (Figure 8).

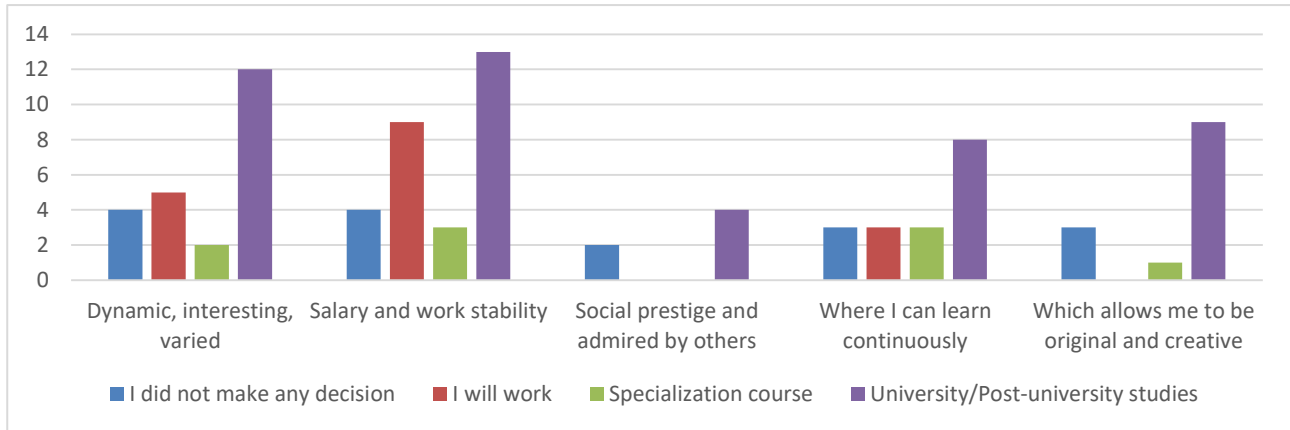


Figure 8 Job expectations

Taking into consideration that gender influences the preferences of respondents, the below emphasizes the expectations of VET learners at the beginning of their careers. The results show different approaches for males and females. It is noticed a similar interest for males for salary and work stability. About 50% of the female

respondents from Turkey choose salary as a priority, while none of the women from Spain considered salary and work stability as a priority. Moreover, about 50% of the male respondents from Spain choose as a priority a dynamic, interesting, and varied job, while none of them prefers original or creative jobs (Figure 9).

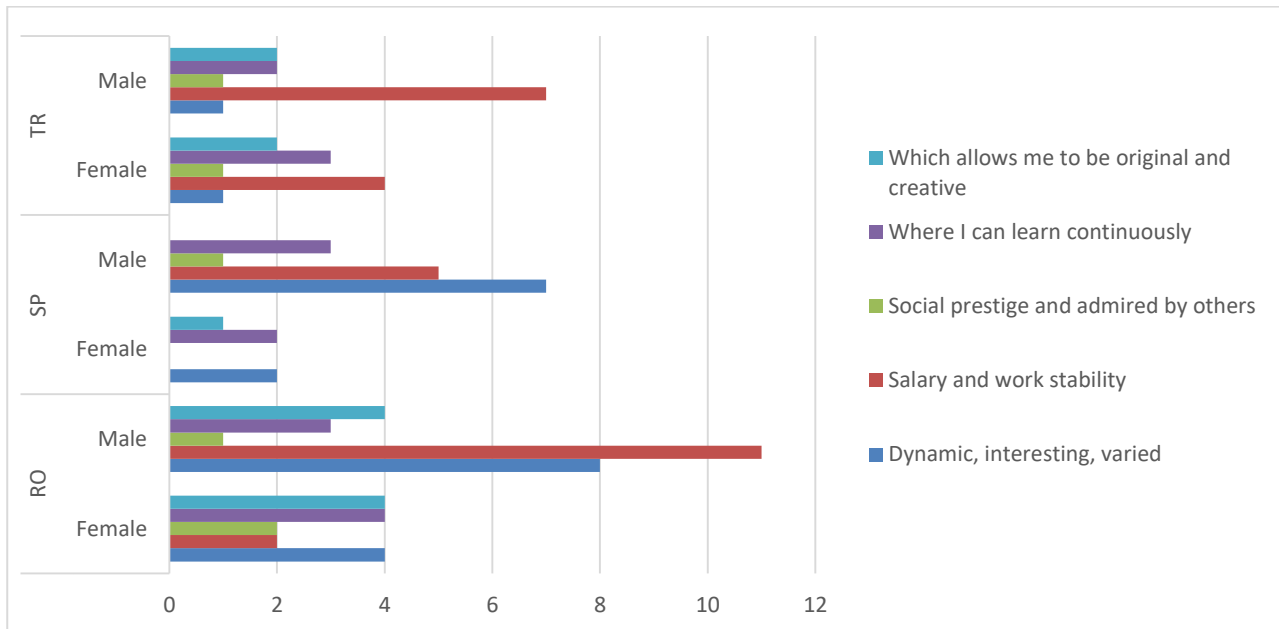


Figure 9 Influencing factors by gender

The large majority of respondents shows interest to meet a professional to guide them in their future career. 80% of those undecided would prefer to meet professionals for getting more information before making the decision. None of those respondents that

would like to follow a course for specialization expected to find information on a dedicated website. Interestingly, even though social media is part of the young generation's daily life, they do not expect to find useful

information for their future career on this platform (Figure 10).

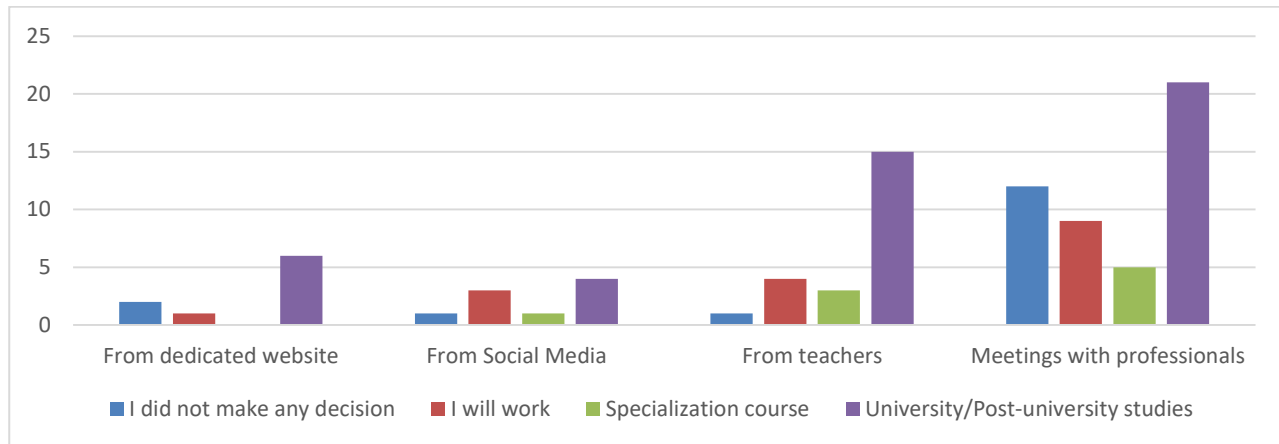


Figure 10 Preferred sources of information for making career decisions

5. CONCLUSIONS

A career plan is a strategy people continuously construct to control their learning and advancement throughout their working life. Its four stages are designed to help them visualize the steps they must take to accomplish their career goals and how to carry out these steps: identify skills and interests, explore career ideas, make a decision, and set achievable goals. The mission of mentors and career counsellors would be materialized if career centres possess the necessary materials to lead people down the correct path, one that is highly developed and constantly expanding. Although many nations strive to advance their ocean economy, success in these attempts is still difficult. Policymakers and educational institutions around the world must transfer a modest portion of their economies in the direction of a thriving blue economy on a global scale. And choosing the right audience for this action will improve the global problem of keeping the blue environment fully active.

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THE IMPACT OF THE PHENOMENON COVID-19 ON THE MENTAL HEALTH OF SEAFARERS

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Abstract: This paper aims to highlight the devastating impact of the imposed restrictions during the COVID-19 Pandemic towards the mental health of the sailing crew.

It is well known that the employees in the navy domain were already accustomed to distinct working conditions, depriving themselves of factors that are vital for a balanced, functional state of mental health. The seamen are subjected to solitude, uncertain and unpredictable weather, a constant fear of danger and the anxiety of being prepared to ensure their own safety at any time needed. This paper aims to highlight the devastating impact of the imposed restrictions during the COVID-19 Pandemic towards the mental health of the sailing crew.

Isolation, research shows, has an impact on both mental and physical health, from reducing the ability to manage stressful situations, to difficulties in making decisions, memorizing and processing information to the onset of depression, anxiety, attacks of panic and increasing the risk of illness, because the immune system of a person responds differently in the fight against viruses.

In this paper were presented the procedures that the crew members of the ships that made voyages in the areas where the imposed restrictions were among the toughest to follow. Also, the mental state of the crew during the voyage and after arrival were analyzed, from in terms of the staff's statements but also individually.

Key words: crew, isolation, mental health, navy, pandemic, restrictions.

1. INTRODUCTION

Sailing is not an occupation suited for everyone, that is a known fact; the conditions in which the navy crew works are also not new. However, what seems to be torturous for the untrained man was balanced with off-shore free time – visiting port cities, testing local cuisine, socializing with the crew – and other people in a more relaxed, less work-oriented manner. Travelling, visiting places – even just for a few hours - not many have access to, and this off-shore time are one of the main motivations that many individuals choose this domain for.

And the pandemic stole this away from them. This, and many others.

2. CHANGES AFTER THE PANDEMIC

After uncertainty and isolation were already more or less a requirement for sailing, COVID-19 deepened the wound with harsh restrictions. At the peak of the pandemic, the restrictions had an incredible impact in Asia, known as the pole of most commercial routes. The installment of rigorous preventive measures inevitably became a great source of stress.

2.1. Experience of a vessel's crew on an Europe-Asia route:

For example, from the experience of a vessel's crew that were away on voyage on an Europe-Asia route during 2020-2021 and that were subjected to the unpredictable changes, it is now possible to analyze the package of safe management measures and the emotional impact it had on the personnel.

According to the "Arrangement for Prevention & Control of NCP in Tianjin Port", due to the gravity of the situation, there were several requirements, such as:

- Declaring the presence of new crew members from or passing through severe epidemic areas;
- Performing daily temperature measurement and health check of all crews two weeks before arrival;
- If any crew have a cough, fever and other physical abnormalities, it should be reported immediately and the vessel is not allowed to enter Tianjin Port until gets the approval;

- No crew shall leave the vessel without permission unless in special circumstances.
- Both the attendances and the ship side should wear protective equipment;
- The business communication between the ship and the port is all online. If there is a special need for document transfer, sealed bags must be used, and shall happen via non-contact transfer outdoors with disinfection.

The requirements from PSA Singapore terminals are similar:

- Any shore-based personnel who is going on board a vessel must produce proof that he/she has a valid negative test result from a COVID-19 Polymerase Chain Reaction (PCR) test taken as part of the rostered routine testing (RRT);
- Shore-based personnel who are not on a RRT program will be required to show a valid negative test result from a COVID-19 PCR test or Antigen Rapid Test (ART) within 72 hours prior to boarding the vessel;
- All vessels berthing at PSA Singapore Terminals must conduct contactless (segregated) cargo operations. This means that during cargo operations, the vessel crew are to stay within the accommodation area of the vessel and to avoid contact with the stevedores working on the vessels.

A general preventive measure during the pandemic was the requirement of isolation that the company imposed on the personnel before boarding, after the flight, was between 1 and 3 weeks, depending on the restrictions of the country, the company and the proximity of the next port.

On top of every previously mentioned restriction, the personnel had to face devastating news about the situation in China on the regular, as well: another city was doomed to a harsh quarantine, another Chinese citizen committed suicide because of the despair the quarantine restrictions ignited in them.

疫情防控期间船舶作业告知书
Requirements for Ship Operations during COVID-19 Epidemic Prevention and Control

各船公司、船长：
To: shipping companies and ship masters

当前新冠肺炎疫情依旧严峻，港口疫情防控，需要港航双方共同努力，密切配合。根据各港口疫情防控工作的要求与部署，我港持续要求到港船舶在疫情期间做好如下配合：

Currently, COVID-19 situation is still dangerous. Port epidemic prevention and control need the joint efforts of both sides. According to the port authorities' requirements, Ningbo port/terminals require ships to cooperate as follows during port stay:



MARITIME AND PORT AUTHORITY OF SINGAPORE
PORT MARINE CIRCULAR
PMO (M) CP 2021
14 Jan 2021

REQUIREMENTS FOR SHORE-BASED PERSONNEL BOARDING VESSELS AT ANCHORAGES, SHIPYARDS, TERMINALS AND MARINAS, IN THE PORT OF SINGAPORE

1. This circular supersedes Port Marine Circular No. 35 of 2020 with effect from 15 Jan 2021.

Proof of requisite test results (Rostered Routine Test results or PCR/ART test results) before allowed to go on board a vessel in port

2. Any shore-based personnel¹ who is going on board a vessel² must produce proof that he/she has a valid negative test result from a COVID-19 Polymerase Chain Reaction (PCR) test taken as part of the rostered routine testing (RRT) programme, within the last 7 days before boarding the vessel. Details of the RRT programme are in Annex A.

3. Shore-based personnel who are not on a RRT programme will be required to show a valid negative test result from a COVID-19 PCR test or Antigen Rapid Test (ART) within 72 hours prior to boarding the vessel. The COVID-19 PCR test (ART) may be done at any of the MCA-approved COVID-19 test providers (https://www.mca.gov.sg/healthcare/healthcare-services/healthcare-services/covid-19-test-providers). After disembarking, these shore-based personnel must take a PCR test between the 5th and 7th day, and a final PCR test on the 11th day. The costs of these tests for shore-based personnel who are not on a RRT programme would be at the shore-based personnel's own or the vessel's expense.

¹ "Shore-based personnel" in relation to a relevant vessel, means an individual who is not passenger or member of the crew of the vessel and is in relevant ports or anchorage areas of the port of Singapore.
² "Vessel" includes harbour craft and pleasure craft.

Figure 1 Various documents with restrictive requirements in Asian ports

It is difficult to be constantly informed of such news, the negativity of the situation deepening the seamen's own unhappiness on deck.

3. THE EFFECTS OF ISOLATION

Isolation during the pandemic is definitely an unpleasant experience. Separation from loved ones, loss of freedom, uncertainty about the stage of the disease and boredom can lead to dramatic effects. In the context of the preventive restrictions, some experts appreciate that the pandemic became the greatest psychological experiment of all time.

Isolation, research shows, has an impact on both mental and physical health, from reducing the ability to manage stressful situations, to difficulties in making decisions, memorizing and processing information to the onset of depression, anxiety, attacks of panic and increasing the risk of illness, because the immune system of a person responds differently in the fight against viruses.

In a survey conducted by the Ipsos company on nearly 14,000 participants from 15 of the largest countries on the globe, it shows that more than two out of five (43%) of respondents claimed they were impatient to return to a normal life. Another third (34%) were concerned about their health, while 15% felt lonely and 12% were dissatisfied with restrictions on personal freedom.

Concurrently, more than half (55%) were worried about the family members who are vulnerable or weak, while just under a third (31%) claimed they were happy



to spend time with their family. Another fifth of those surveyed (22%) were inspired by people who adapt. The mixed responses in terms of the emotions felt may actually reflect how isolated people really are, according to experts, who say that the more severe the isolation, the greater the psychological impact. [4]

It goes unsaid that the navy crew members who were unfortunate to be on deck during the peak of the pandemic have experienced multiple negative emotions: fright, despair, hopelessness, anger. And worst of all, loneliness, because it was just them and the overwhelming body of water, with not much but on-board routine to keep them sane.

Needless to say that everything they were experiencing at the time was not only physically stressful, their bodies growing more exhausted every day, but also mentally stressful. When such situations happen, people are prone to developing mental health imbalances, such as depression, anxiety, chronic fatigue, burnout. These conditions, although they are different, are closely related, have common characteristics and affect the nervous system.

4. THE AFTERMATH OF EXPOSURE TO LIFE-THREATENING SITUATIONS

Broadly, stress is a psychosocial phenomenon characterized by states of tension and mental discomfort determined by external factors that are perceived as aggressive, difficult or painful. Short-term stress can be beneficial to the body as it can act as a catalyst to help mobilize challenging situations, however chronic stress can seriously damage one's health.

With the constant uncertainty the seamen had to bear in long, seemingly endless voyages, stress was no longer physical; the crippling depression and anxiety the pandemic caused were extremely demanding for the brain, leading to what is called mental stress.

Mental stress is defined as a syndrome constituted by the exacerbation of psychic reactions and their somatic correlates (affecting almost all body compartments) in connection with external excitation or internal exerted by stressor agents that act intensely, unexpected, sudden and/or persistent and sometimes having a symbolic "threatening" character, other times an extremely favourable role for the subject (perceived or anticipated as such by the subject).

Distress is the term that designates stresses that have harmful potential for organism. What needs to be emphasized is related to the main hormones released in the course of distress:

- catecholamines (especially noradrenaline and adrenaline) - which can favour cardiovascular diseases;
- and cortisol, which lowers the body's resistance to infections and cancer.

In medical literature, distress generally covers the scope of the notion of stress appearing in a series of situations with extremely unfavourable meaning for most

individuals and for this reason the word "stress" is commonly used with negative connotation. [3]

After the preventive measures were at last less restrictive and the personnel had the chance to return to their families, the distress would not end there.

Due to the hectic, repetitive lifestyle the members adopted in the midst of the pandemic, their bodies got accustomed to having an occupation at all times – they are left restless, unable to relax even when there is no sign of threat or urgency.

After only communicating with people from the vessel at, most likely, a superficial level, communication with the loved ones was difficult, more formal, perhaps insincere, because it is emotionally demanding to open up about traumatic experiences. Moreover, it was also unnatural to talk freely at home, when for several months (or even years) the main subjects of conversation were work and adapting to the everchanging rules. They may think the past is in the past, but their bodies remained in a state of defence.

Even though on a safer terrain, each crew member felt the effects of isolation in the long run, feeling various negative emotions: inexplicable irritability, a sense of danger, lack of motivation, paranoia, apathy. It is impossible to sweep such stressful years under the rug.

5. SOLUTIONS

The next step would be returning to the normal state in which life used to be, before the pandemic. However, that is an impossible request; therefore adapting to the current situation seems to be the only choice.

There are definitely helpful solutions to ameliorate and the reconstruct the shaken mental health of the crew members. Indubitably, rest is absolutely essential for an efficient recovery, as well as developing relaxing hobbies such as gardening, yoga, practicing a sport etc. Meditation and breathing techniques have proven to be very useful in situations of great stress.

Quality time with the loved ones and engaging in favourite activities definitely help ameliorate the tension, too.

Worst case scenario, all crew members should be granted access to professional help – psychotherapy - if necessary.

6. CONCLUSIONS

The COVID-19 pandemic was undoubtedly very impactful for millions, billions of people. Several lives were affected, physically, psychologically, financially and in many more other areas, by an unpredictable virus that to this day has not stopped to spread.

This paper's aim was to cover, broadly, how truly impactful the pandemic was for the marine domain, by focusing, in the first chapter, on how an already demanding field of work was aggravated by harsh restrictions. In the second chapter real documents and



examples of restrictions on various vessels were shown, to enhance how the situation was both rigid and erratic with incredibly strict rules that were changed day by day. These restrictions imposed even more isolation for the crew members, effects of which were presented in the third chapter. In the 4th chapter, the consequences – physical and mental - of living in a constant state of danger were described, even after the danger was no longer there. The employees in the marine field, the residents of vessels, were subjected to difficult conditions, that leading to depression, anxiety, stress and even medical issues. Fortunately, there are always solutions for a better quality of life, which were presented in the 5th chapter.

All in all, the efficiency and productivity of a crewing company depends on the well-being of all its members. Therefore, it is extremely important to enhance the focus on the mental health of all employees – everyone benefits when companies support and promote mental health for those who are suffering.

psychological evaluation within each compulsory medical visit before a voyage. According to the results, the crew members should be given a compensatory recovery time directly proportional to the amount of time spent in moments of crisis.

It is of utmost importance to maintain and focus on the mental health of the employees – the more affected, the more the entire crew suffers. One less efficient

member makes the work load more demanding for the others, having an impact on everyone's health.

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EVALUATION OF THE SPECIFIC HEAT CAPACITY (SHC) OF WATER- Al_2O_3 NANO FLUIDS BASED ON A THEORETICAL MODEL

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Abstract: Adding of nanoparticles in a base working agent leads to Nano fluids representing of a new type of working fluid. Due to an increase surface area, there is a gain in the surface area needed for heat transfer between nanoparticles and base fluid. Sein the poor heat transfer properties of water, water base Nano fluids present improved heat transfer performance and require smaller heat exchangers. This paper deals with the estimation of specific heat transfer capacity of water- Al_2O_3 Nano fluid. The decrease of volume concentration, from 13% to 3%, will reveal a gain in SHC of 27% - for nanoparticles diameter of 60 nm and a gain of 40% - for 30 nm diameter. At high temperature, SHC shows better values, also when the volume concentration is lower.

Key words: water, heat transfer, performance, specific heat capacity, Nano fluid.

1. INTRODUCTION

We name as heat transfer fluid the working agent used to transfer heat from mediums with different temperature.

In modern times, the wise use of energy is a major issue; it is aimed the ensuring of a safe future and a sustainable development.

This desiderate might be achieved by the use of new sustainable heat transfer fluids.

Heat transfer fluids are chosen in compliance with the technical application, given temperature range, specific to a proper exploitation, and life time of heat transfer fluid.

The heat transfer fluid should respond to the following characteristics:

- *high thermal stability when working with high temperature values,
- *good resistance degradation in the above mentioned situation,
- *good correlation between pressure and temperature values,
- *low freezing point,
- *non aggressive behaviour to the materials used in the system,
- *safe behaviour from toxicity and flammability point of views,
- *good environmental behaviour.

When working with liquids, the following benefits appear:

- *generous temperature range of operation,
- *quick temperature variation,

*diminished heat losses in comparison to the case of vapour systems,

*low operating pressure values,

*smaller pipe dimension compared to vapour systems.

Nanotechnology is an engineering science working at nanoscale, meaning $1\div 100$ nm. This technology, which enables the work with individual atoms and molecules, is involved in many traditional sector, such as physics, chemistry, engineering sciences, etc.

With the implementation of nanotechnology, appeared a new type of heat transfer fluids, called Nano fluids. Nano fluids results from adding Nano size particles in a base fluid; these nanoparticles might be metallic, metal-oxide and even not metallic provenience.

Nano fluids are known for an improved thermal conductivity, found in an improvement of heat transfer rates. That is why the use of Nano fluids leads to a better energy efficiency, higher performance and diminished operating costs [1].

Nanoparticles, present in Nano fluids, improve the properties of the base fluid, such as: viscosity, density, specific heat capacity, thermal conductivity, etc. – properties that influence the heat transfer process; for this reason Nano fluids might replace successfully water in heat transfer processes [2].

Given the situation described above, in the specific literature are provided the following advantages of Nano fluids [3]:

- thermal conductivity of Nano fluids;
- fluids is enhanced due to dispersed nanoparticles;

- there is a better connection between the base fluid and nanoparticles, resulted from the surface of these nanoparticles;
- added nanoparticles generate Brownian motions that have positive effect on the interaction base fluid-nanoparticles;
- added nanoparticles increase turbulences and mixing fluctuation;
- there is a lower need in pumping power compared to the use of the base fluid.

The preparation of Nano fluids needs special attention. The reason is that Nano fluids must be characterized by specific durability, stable suspension of added particles, no chemical reactions, negligible agglomeration of nanoparticles.

The two methods use to prepare Nano fluids are as given [4]:

- one step method – when the preparation of added particles and their dispersion in the base fluid occur simultaneously
- two step method – which is more economic, involves the preparation of nanoparticles throughout different ways and after that, their dispersion in the base fluid.

Should be also mentioned the fact that Nano fluids require important costs of production, being advised the recycling of added particles from industrial wastes [5].

As a traditional working fluid in several industry sectors, water shows poor heat transfer behavior, translated into low performance and big sizes of the equipment; by adding Al_2O_3 nanoparticles in water will be obtain water- Al_2O_3 Nano fluid which will be expected to have better thermo-physical properties than water [6].

According to Hasan et al (2018), water- Al_2O_3 Nano fluid shows enhanced thermal conductivity values than water (see Table 1) [7].

Table 1. Thermal conductivity of water- Al_2O_3 Nano fluid, diameter = 20 nm

Al_2O_3	32 W/mK
water	0.6215 W/mK
Nano fluid 5%	0.62238 W/mK
Nano fluid 15%	0.62414 W/mK
Nano fluid 20%	0.62502 W/mK
Nano fluid 30%	0.62679 W/mK

Since specific heat capacity influences heat transfer processes, this property is estimated throughout available models and corrections [8].

This paper deals with the assessment of specific heat capacity (SHC) of water- Al_2O_3 Nano fluid by the use of Zhou et al model.

Will be found the influence of the concentration on SHC and also the effect of temperature variation on SHC.

2. METHODS AND MATERIALS

SHC of the nanofluid means the capacity of this new working fluid to absorb heat without changing its phase.

According to the selected model, SHC of the nanofluid is assessed by the use of the following formula [9]:

$$SHC_{nf} = \frac{\varphi(\rho SHC)_{np} + (1 - \varphi)(\rho SHC)_{bf}}{\varphi\rho_{np} + (1 - \varphi)\rho_{bf}}, \quad (1)$$

where subscripts:

np – nanoparticle

bf – base fluid

nf – nanofluid

and where

ρ – density

φ – solid volume fraction

The volume fraction of Al_2O_3 nanoparticles is obtained by using the below equation [10]:

$$\varphi = \frac{m_{np} / \rho_{np}}{m_{np} / \rho_{np} + m_{water} / \rho_{water}}, \quad (2)$$

where:

m – mass.

3. RESULTS AND DISCUSSIONS

In Figures 1 and 2 it is provided the effect of volume concentration (φ) on the specific heat capacity of the nanofluid (SHC). In the first figure, nanoparticle diameter (d) is 60 nm, while in the second one, diameter is 30. In both cases, temperature of nanofluid is 30°C.

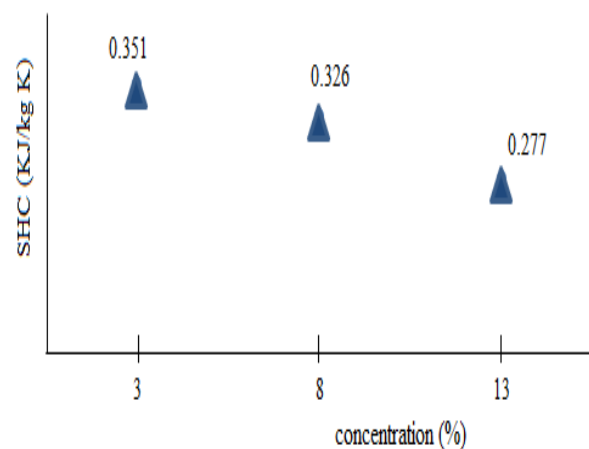


Figure 1 Effect of φ on SHC, d = 60 nm

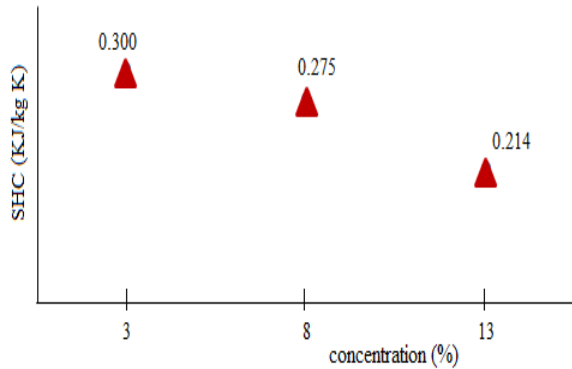


Figure 2 Effect of ϕ on SHC, $d = 300$ nm

In both cases, it is observed that the increase of concentration will lead to lower specific heat capacities. Better values for SHC are found when nanoparticles diameter is higher.

In the given case, the increase of SHC with decrease of ϕ is 27% - when $d=60$ nm, respectively 40% - when $d=30$ nm.

The influence of temperature (t) on Nano fluid SHC, for the above mentioned concentration is provided in Figure 3.

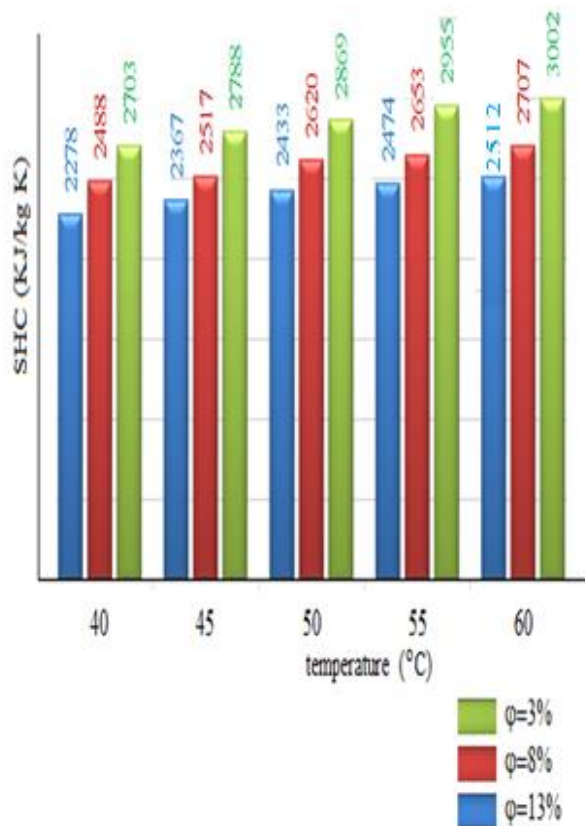


Figure 3 Effect of t on SHC

As known for classic working fluids, the temperature increase will reveal better values of Nano fluid SHC.

For high values of temperature correlated with low values of concentration, results enhanced values for Nano fluid SHC.

The gain around 19%, considering the maximum and the minimum concentrations.

4. CONCLUSIONS

Water based nanofluids are recommended to be use instead of water in heat transfer processes.

The prediction of heat transfer capacity values is important in design of heat exchangers.

By the help of models, heat transfer capacity can be estimated for different concentrations of nanofluids.

In the present study, the variation of concentration in the range (3 – 13)% of water- Al_2O_3 nanofluid resulted to decrease together with the increase of the concentration.

This trend is observed for two types of nanoparticles diameter.

Specific heat transfer capacity increases with temperature increase and with concentration decrease.

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HURDLES IN APPROACHING SCIENCE AND IN SOLVING CLIMATE AND ENVIRONMENT ISSUES

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Abstract: Showing complicate issues in science, like the strange facts and realities pertaining to the quantum world, this paper explains why it is so difficult to understand and to solve those complicate issues. This paper also stresses the important fact, that in order to understand these strange realities pertaining to the quantum phenomena but also in order to solve other complicate problems of science such as the climate change issues, one should give up the traditional way of thinking of the science and should also renounce the false idea of the rationalism, stating that the entire reality can be known and understood by using scientific reasoning.

Keywords: quantum phenomena, rationalism, binary logic, multivalent logic, limitations due to human senses, multidimensionality, thresholds, extra dimensions, weights assigned to dimensions.

1. INTRODUCTION

This paper is based on a previous paper of the author [12], which has been updated and completed with additional information pertaining to other published work of the author, [13], [14] and [15].

In the Greek and Roman ancient worlds, the scientific knowledge was found in the philosophic schools pertaining to those cultures.

After the fall of the Roman Empire and the rising up of the Christian faith, the scientific knowledge has been transferred to the churches and monasteries, the science found there being always based on the explanations accepted and given by the Church.

The age of the humanism has brought forward the importance of the rationalism and its false conclusion that almost anything could be explained by using the human reasoning.

This conclusion has also determined the schism between the science and religion.

The discovery of quantum phenomena more than hundred years ago has proven that the rationalism alone cannot explain the weird phenomena belonging to the quantum world.

The relationship within this paper between the religion and science, although not an explicit one is an implicit relationship.

Without admitting the limits of the rationalism and without admitting the existence of unknown forces and hidden truths escaping our senses and rationality, one cannot adequately approach the world of quantum scale phenomena.

In order to approach and explain the quantum phenomena, the link between them and the normal scale and large scale phenomena should be somehow established first.

The work is concerned with the difficulties in detection of links between normal scale and small scale phenomena, that is to say common features and characteristics exhibited by both, normal and quantum scale phenomena.

These common features which are namely the link between the quantum world and the real world are permitting to connect the small and the normal scale phenomena. They are useful to understand better the quantum phenomena and they are also showing that many of the quantum world rules are applying also for real world systems.

The last evolutions and discoveries in the present day science, and especially the phenomena pertaining to quantum world, have proven that the unilateral and one dimensional traditional way of thinking of the pure rationalism is not sufficient anymore to explain the facts and realities of the science.

The work also shows that, when dealing with quantum phenomena a “special” kind of thinking is required, mathematics should be used at its highest peak and some of the “usual” and “absolute” truths and the “sound” judgments of the plain and blunt rationalism which may hinder the understanding of the quantum world are to be renounced.

The approach of the work is to explain in the first instance, in a more descriptive way what are the reasons lying behind the writing and the similarity between the quantum world and the normal scale world, analysing



and explaining why the restrictive limitations of the pure rationalism should be abandoned.

These limitations are to be replaced by newer, more modern and more adapted kinds of thinking, while the next part is representing the prescriptive part, being a little bit more technical and concerned with providing and finding solutions, explanations and theory based prediction methods of the quantum world phenomena, as well.

Throughout the work a special feature of the quantum systems and phenomena will be addressed, that is to say the feature of multidimensionality, feature which is also exhibited by most of the real world (normal scale) phenomena, and therefore easier to be dealt with.

The evolution in quantum systems (more dimensional systems) may follow variation laws pertaining to the theory of *Time Series* or to the theory of *Signal Processing*, which could be systemized along with possible norms to be applied to those more dimensional quantum systems.

Because our present state of knowledge related to the quantum phenomena is related to the knowledge of the existing probability wave function of the respective quantum phenomenon, the transition between the states of the quantum system can be derived using the characteristic function of the probability density function, which is in this case, exactly the Fourier Transform of the probability density function.

Since there are serious limitations caused by our limited senses, perceptions and thinking (that is to say there are hidden dimensions for us), another issue to be approached is to retrieve the information pertaining to those dimensions hidden to our abilities and senses.

One of the methods we could use for this is to reconstruct those hidden dimensions based on the *spectral analysis* (Fourier Analysis), this kind of techniques being actually nowadays successfully applied in Quantitative Phase Imaging, where the image is reconstructed out of its spectrum.

Unconventional thinking is almost always required when is necessary to address complicate issues such as certain intricate problems in science or the complicate issues related to climate and environment.

Using these methods, one could infer about the facts and phenomena underlying to the observed effects of the quantum world phenomena and could also find explanations for them, but could also identify patterns in the evolutions of the quantum phenomena.

2. HURDLES IN LINKING RELIGION AND SCIENCE

Some scientists are criticizing new science as being fiction, science fiction of philosophy. But, many of the fiction and the science fiction facts, not so far back in time (such as Jules Verne's books or more recently the Star Trek movies) have already become nowadays' technology.

A lacking capacity to dream may seriously impair the work of the scientist, since it is leading to a diminished creativity.

A very good example on how the science is approaching more and more the science fiction is the evolution in the field of the molecular machines, categorized in the early '80s, by many scientific researchers as being phantasmagorias without any future. As it is already known the Nobel Prize for Chemistry 2016 has been awarded exactly for these so called "phantasmagorias" from around 1980.

That is why we can further infer that much of the nowadays' science fiction and philosophy is the science of tomorrow.

Another good example on how the scientists should be always prepared to understand and accept new ideas is related to other "classical" ideas, which are nowadays confronted with contradictions pertaining to the new discoveries in the field.

According to the laws of the chemistry, until recently was well known the fact that he cannot form stable compounds with Na. But recent research has shown that at extremely high pressures, these "classical laws" of the chemistry are not valid any more, and at very high pressures, within the gas planets He and Na could form stable compounds, contrary to the general "classical" belief.

Affirmations like: "Two bodies cannot simultaneously occupy the same volume of space" which are valid in the world of normal scale phenomena, are not anymore valid in the world of quantum phenomena. Also the rule regarding time, which is supposed to flow only in one single direction, it also loses its validity in the realm of quantum phenomena, exactly like in the case of the dark matter which is supposed to obey completely inverse rules than normal matter.

Without reading, understanding and eventually using philosophy and philosophic ideas, the most recent new theories and science, such as the *Theory of Relativity or Quantum Mechanics*, would not have been probably discovered.

Complicate scientific issues such as quantum theory or solving climate and environment issues cannot be approached only based on a narrow rational thinking. That is why they have to be addressed not only using new original creative solutions, but also using ways of thinking which may sometime contradict the usual logic or they may very well be counterintuitive.

So, when one issue is so big or it has grown to become so big (as in the case of climate issues), cannot longer be approached in a classical strictly logical manner, but merely by using unconventional solutions and new ways of scientific thinking.

The future of the science belongs to those who will have the ability to see something where nobody sees it, or to see the things otherwise than others do.



In order to do this, the future scientist will have to have additional backgrounds in various different fields of sciences.

Because a singular science is representing only one limited and narrow way of thinking, the only limit of the science is the respective science itself.

If you are anchored in only one science then you are more prone to limitations than those who are thinking in more than in one singular way, corresponding to their own single science.

The present days science problems can be solved only by approaching them in a more complex and holistic way, or if can cite A. Einstein: “the complex problems we are confronting today with, cannot be solved remaining at the same level of knowledge where we were when they have been generated” or in his other different words “it is stupid to do the things repeatedly, in the same way and to expect different results”.

The use of the “pure rationalism” in science has reached its limits and the weird quantum phenomena the science is facing, cannot be explained anymore only by using the limited view of the rationalism.

The link between the large scale phenomena described by the Theory of Relativity and the small scale phenomena, the science is still struggling to understand, that is to say *the Quantum Theory*, as it is presented in [1], [2], [3], [4], [5], [6], [7], [8] and [9] cannot be found unless the missing link between the normal scale and small scale phenomena is previously detected.

3. SOLUTIONS FOR SOLVING THE HURDLES ENCOUNTERED

This section presents potential successful ways to approach complicate science issues

3.1 *Conventional logic, paradoxes and complicate science issues*

In order to somehow grasp and understand quantum phenomena, it can be remarked that one of the rules of the quantum world is also applying to the normal scale phenomena and systems (real world systems), and that rule is the rule of *multidimensionality*.

In order to sustain this remark one can name at least two examples proving this remark: the so called paradox of the truth machine belonging to Kurt Gödel and the so called paradox of the rationalists: “could God create such a huge stone that He Himself cannot lift?”

In the paradox of the K. Gödel’s binary logic truth’s machine, this machine enters into contradiction with the simple binary human logic and is silenced since cannot make any further statement, because it would contradict this logic. One another interesting point of view regarding the muting of the truth’s machine is provided by B. Marchall in his paper [11]. The silence of the machine is based on the fact that the machine is intelligent enough to understand and to know that “the

truth is bigger than itself and she develops the intuition that there is something transcending her” and the only reaction she can have is to remain mute and be silent, this reaction showing her own humbleness and modesty with regard to all what she does not know.

A beautiful definition of science is given by the same author above in [11]: “Science is modesty. It is born with doubt, lives with doubts and always leads to more doubts and more questions”.

This definition should also help man to approach more humble and hence more successfully the today’s complex problems of science and of Earth, if they really want to solve these issues.

Both of these paradoxes are based on the simple rules of binary logic, and they are both demonstrating the same thing, namely the limits of the binary logic system itself.

As mentioned before, K. Gödel and also A. Einstein not only observed that such kind of paradox problems cannot be solved using the same system of thinking that has generated them, but they also pointed to the limits of the scientific rationalism itself, that since the discovery of the quantum phenomena is getting into more and more troubles.

That is why, one of the first things should be done when dealing with and when approaching quantum phenomena is to throw away the “simple and clear” one dimensional binary logic and even the trivalent logic introduced by the polish Jan Lukasiewicz in 1917, which are clearly proving not to be valid anymore in the quantum world.

So when dealing with quantum phenomena, we should give away the “usual” way of thinking and look at the truth as to a more complex concept than it is viewed according to the binary and trivalent logic. We should rather adopt the multivalent logic or even the fuzzy logic inspired by Lotfi Zadeh, according to which, between the 0 and 1 there are a finite number of possible values or, as it is considered in the fuzzy logic systems, there are an *infinity* of possible values and solutions.

The multivalent logic and the fuzzy logic as well, are both solutions to the problems stated by the previous paradoxes. In this way, it shall be discovered that the truth is in reality, almost always, more complicated to express than in terms of “yes/no”, “zero/one” or “white/black” and the truth could be often determined only using much more than only one dimension.

Expressing truth using two, three, four or more dimensions could be made using laws, rules and limits but also weights for each of those dimensions.

If for the rational (human) world system the rules and the limits could be established as being the same for all humans, the weights associated to each of those dimensions of truth (rules and limits) are obviously different from human to human, as it is known everybody has his own sense for how important different things are.



In this manner we are coming closer to one of the main characteristics and features of the quantum world: the fact or the observation (the knowledge or truth) is *depending on the observer* (by means of the weights the observer is assigning to each dimension of truth/knowledge, at a certain moment, and truth is becoming thus relative to observer).

This is meaning that, what is true for someone could be false for someone else, and also that the same thing could be both true and false at the same time for different observers, or could be both true and false, at different moments, even for the same observer.

This is again, obviously, one of the main features the quantum world and phenomena is exhibiting.

Hence, one of the first main remarks which has to be done related to the truth/ knowledge when dealing with of the quantum world phenomena is that the “rationalistic absolute truth” has to be firstly thrown away and in henceforth no one among humans could claim to possess the “absolute” truth.

When assessing truths and facts in more dimensional real world systems or in quantum systems as well, one should have to know the variation (or evolution) *laws of the respective dimensions*.

These are forming the system of truth, the weights assigned to each of those dimensions, but also the formula of the norm of the respective system.

The norm is linking the values of the respective dimensions with their respective weights, thus resulting the aggregate value corresponding to one particular state of the system.

An explanation to the different values (of truth) observed by more observers, fact which is also exhibited by the quantum phenomena, is the fact that the observations should comply with the rules within the systems of these observers.

A second idea linked to the characteristics of the quantum phenomena is that, there are certain dimensions pertaining to the multidimensional structures corresponding to these phenomena, which are hidden to the eyes and senses of the man.

These dimensions are usually called *extra dimensions*. This is an additional explanation for the facts and results perceived during the quantum experiments, namely that they appear to have no logic and they make no sense for the human mind.

In reality this could be, on the one hand, the wrong interpretation of the result generated by the multidimensional structure, and on the other hand could be the effect of the existence of those hidden dimensions combined with the limitations caused by our senses.

In the same manner as explained before, it may be very possible that the observed quantum particles are moving also in dimensions which are extra dimensions for the observer.

For the quantum phenomena this fact could mean that there may be extra dimensions of ourselves (all human observers of the quantum world) and, as already

stated in the scientific literature of the quantum mechanics, the pilot wave of the respective quantum particle could be a real wave pertaining to a dimension hidden to the human eyes and senses.

Consequently, other methods of measuring of the realities in the quantum world should be implemented.

Another third concept producing the facts observed in the more dimensional systems pertaining to the quantum scale is the concept of the *threshold*.

This concept could be applied in normal scale multidimensional systems in the following sense: if the aggregated value of the system, at a particular moment in time is smaller or is exceeding a certain value (threshold value), then the value of the system in that particular moment cannot be read.

The difference to the previous idea is that this concept of threshold is regarding, in this case, only the “measured” result caused by the multidimensional structure.

For the case of real world systems there are indeed such thresholds for which the values cannot be read due to our limitations caused by our limited senses.

For hundreds of years the man has put himself and his own thinking in the center of the Universe. He made this applying the very same way of thinking when he has firstly put his planet, then the Sun in the center of the Universe. Then, with the expansion of his own knowledge he was gradually forced to admit that neither the Earth nor the Sun are lying in the center of the Universe, but are only small dots in a Universe map much bigger than originally thought. Unfortunately and mostly due to his own vanity he was not able to transfer the same way of understanding and wisdom upon his own thinking, and presently he is still thinking himself as the ultimate thinker, being able to understand all without any limitations and surely convinced that he can explain and understand all using only his limited binary reasoning.

The next step in order to better understand the reality of the quantum world and its phenomena is to renounce such narrow, limited and absolutistic way of view and thinking. He has to admit truths that are nowadays escaping to such self-sufficient “normal” and “sound rational” judgment and to also renounce the judgment according to which the man’s binary logic and reasoning is the best tool to understand the world.

The first step toward such a way of thinking has been already done by means of technology, that carries us out away beyond our senses and it gives us a good idea about both, on the one hand, the very serious limitations we are exposed due to our senses and on the other hand, our rather small place in the Universe.

Although the observation of the real world systems and especially of the quantum world is seriously limited by our senses, the actual main limitation could be caused by our own “absolute” way of reasoning.



We are more and more close to the level where our limited senses are assisted and completed by the available and continuously improved technology.

However, in spite of this nowadays improved technology the stumbling stone for man may be represented by his own way of reasoning. The human's reasoning has remained somehow far more behind the technology, somewhere back in time, in the thinking ways of the XIX century.

In [10], a very interesting book of Friedemann Schulz von Thun regarding the psychology of communication, the scientist was expressing the idea that the man is very badly outfitted with his only two ears, since the communication process is a much more complicated process, having at least four main aspects that could be considered during the communication process.

In the same manner, the scientist, with his one brain and five senses seems also to be very poorly outfitted for perceiving and understanding the science facts. In the very same way, his five senses and the one brain seem not to be enough for approaching more complicated phenomena such as the quantum phenomena, fact which is a serious foothold to stumble.

At the time of the pure rationalism, the man had the very "unusual" and strange idea that he could explain almost anything using only his limited true/false logic. Unfortunately, the strange phenomena happening in the quantum world, recorded based on the latest technology, are already, again and again, proving that this non-productive way of thinking has remained behind both, the new technologies and the corresponding recorded facts. Hence, change of this manner of thinking is strongly recommended and required.

The time of the rationalism, able to solve any problem and to answer any question is off.

We have already entered an era in which, as the things get more and more complicated, the science phenomena cannot be explained anymore by using the traditional manner of the narrow rationalism.

The human rationalism pertaining to the XIX century and the beginning of the XX century should be redefined. From the perspective "the man could discover and explain almost anything using only his own reasoning and senses" into: "we are human beings not only limited in space and time, but also in our knowledge".

A man of science should be a man of the reality, trying to observe, analyze, understand and describe the reality but also admitting that often the reality is far weirder and more astonishing than the expectations of man. Many times the men of science are lacking the capacity to understand and to explain it.

Expressing his opinions on the difficulties met in the science, A. Einstein said that God did not created the world around us with the intention to be easily understood by man. Hence, huge efforts are necessary in

order to exceed limits and the limitations imposed by our own minds.

As Niels Bohr has declared in one of his statements: "It is decisive to recognize that, however far the phenomena transcend the scope of classical physical explanation, the account of all evidence must be expressed in *classical* terms".

The term used here, "*classical*", Bohr is using, should be interpreted as referring to the new stage of science which should be reached, in order to explain the quantum phenomena, and not to the present stage of "classical" knowledge in physics.

Another feature of both, normal scale and quantum phenomena is the *interdependence* of each of the both. Interdependence is usually called correlation in regard to normal scale phenomena and entanglement, with regard to quantum phenomena. When presented to him, A. Einstein named the quantum entanglement "spooky action at distance", because it is so hard to understand it and to represent it.

We could easily imagine that the law of interaction between objects in the macroscopic world, the Law of gravity discovered by I. Newton, has been seen by many scientists of that times, at its discovery, also as a "spooky action at distance".

Even now, after centuries of science, although the gravity is the first force that has been discovered (out of the 4 main forces of interaction known), it is nowadays, actually the least known and understood force of interaction.

3.2 *Basic rules to address and to deal with hurdles encountered in science*

The previous presentation of facts regarding the "classical" view in science is sustaining and enforcing the statement and the viewpoint according to which, the "classical" is almost always meant as referring to the certain stage reached by the human knowledge, understanding and science. This present stage is nowadays not able to explain the phenomena encountered in scientific experiments.

In order to better understand the facts within the quantum world and to succeed in explaining them we should change not only the view on the "classical" theory of physics and the interpretation of measured results. Instead, we should change the whole way of thinking with regard to science when dealing with quantum phenomena.

The classical rationalism is operating mainly in deterministic ways. This fact is both convenient and easy to perform and understand by every human mind, on one hand, because it is in accordance with the human limitations and hence, it fits better to our limitations, and on the other hand is more likely and more easily accepted by others. It is also more easily accepted by the science community than other "unconventional", non-



deterministic alternatives that are trying to deal with more solutions or even an infinity of possible solutions.

As we all know, the infinite is a more difficult concept to grasp and to deal with, and at the same time much more difficult to describe and represent. The accepted solution is in many cases to split the infinite number of possible solutions into a finite number of classes with infinite solutions. In this manner one can reduce the infinity to certain finite number of classes, each of them containing an infinite number of solutions. The great difficulty in this case is usually to find the rule (or the algorithm) describing each of the classes.

This is the also the case of the fractals, the fractal although infinite is based on a (very often) simple rule of generating very complicated structures. The fractal systems are, in the very same way as the quantum systems, dynamic systems.

In order to better understand the quantum phenomena and how they are related to the normal scale (macroscopic world), more actions could be performed. In that sense one could use the possible change of the existing measuring devices, the possible change of the measuring methods, and the reinterpretation of the obtained results. The change of much of the way of thinking should be also seriously taken into account.

The high computational capacities from nowadays are permitting better the simulation and comparison of results linking the quantum scale and a normal scale phenomena, in the sense of the present work.

One could systemize the laws of evolution (laws of variation) of the dimensions taken into consideration for the multidimensional structure of both (quantum and normal scale systems).

This can be made by taking into consideration both, the multidimensionality and the dynamicity of the systems as well, using, for example, recursive rules for the evolution.

4. CONCLUSIONS

The difficulties related to the understanding of the quantum phenomena or other complicate science issues, are mainly deriving out of a certain limited human way of view and thinking.

The difficulties the man is struggling with, more than hundred years, regarding the quantum phenomena, could be already considered as an opportunity to reconcile science and religious belief.

The re/convergence of science and religion could be the most adequate way to address those phenomena, since everything else has failed to explain them.

These difficulties in understanding the quantum world can be attributed to the limited rationalism working based on the simple binary logic, which is not able and cannot explain the strange things happening within the quantum scale phenomena.

Man should understand that today, although much better technically equipped in comparison with the past,

he is seriously impaired not only by his senses, by the number of his senses but also due to his own brain's and his own technology's limited processing capacity.

Instead of this way of thinking which is not valid anymore when dealing with the quantum phenomena, the multivalent and the fuzzy logic but also other "non/conventional" methods should be used to understand the obtained results.

Multidimensionality and threshold are further concepts that could explain a great deal of the weird results obtained in the experiments pertaining to the quantum world.

The humanism and its consequent rationalism have determined the schism between the science and religion. The discovery of quantum phenomena more than hundred years ago has proven that the rationalism alone cannot explain the weird phenomena belonging to the quantum world.

The dialogue between the religion and science within the paper, although not an explicit one it is assuming an implicit relationship between the two.

Without admitting the limits of the rationalism and without admitting the existence of unknown forces and hidden truths escaping our senses and rationality, one cannot adequately approach the world of quantum scale phenomena or other serious issues of science.

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THE LOGIC OF HAPPINESS AND ITS RELATIONSHIP WITH ENVIRONMENTAL AND CLIMATE ISSUES

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Abstract: This paper is concerned with the logic of happiness, whereas happiness is most commonly seen by man as a function of fulfilled wishes. It also shows the disastrous consequences for man and his home planet when engaging in this damaging way to search for happiness. This paper also shows that the main reason for consume and overuse of planet's resources is that man has been trained to consumerism by various tactics and strategies which were applied to him in the recent past, with the purpose of making him "successful" and a "good" citizen. This paper also provides some more conventional and some more nonconventional solutions to undone this evil of the "induced" necessity to consume in order to be happy

Key words: happiness, consume, consumerism, climate change.

1. INTRODUCTION

This paper stresses the unusual, unnatural and improper way men search for happiness in the present, disregarding God and His creation by polluting and overusing resources of our home planet.

Human happiness is most commonly seen as nothing more than as a function of man's fulfilled wishes. People often see no happiness in the absence of an exaggerated consume. They were successfully trained to be "faithful" consumers and "good" citizens, with disastrous effects on planet and on their own health.

By understanding the reasons, causes and the models associated with the consumerism, one can find more or less conventional solutions to abolish this damaging consumption behavior.

Such as already mentioned by some authors [1], science may very well be much more a matter of faith, and much less an objective construct of the man's reason. According to this referenced paper, "science is modesty".

For almost a century now, man has realized how large what he does not understand is. In the search of explaining what he does not understand, man enters into greater and greater predicaments. The paradox of science is that despite knowing more and more, man realizes that what he does not know is increasingly larger.

The true scientist is aware that man only can master, explain and understand a very small portion of what is around him, and that is the reason why he should show humbleness and modesty when confronted with big issues of science.

2. HUMAN HAPPINESS, ITS RELATIONSHIP WITH CONSUME AND CONSUMERISM AND THE IMPLICATIONS FOR THE PLANET

As it will be presented in this paper, almost always man sees his own happiness only as a function of his fulfilled wishes. Often times, this view seriously impairs his capacity to act rationally and in his rush to fulfil his wishes, man disregards important laws of nature and the consequences of his foolish actions.

Significant issues relate with this way man understands happiness, feeling often seen by man only as depending of his fulfilled wishes. Man almost always has seen and still assesses and sees his own happiness as a function of his own fulfilled wishes. He often times does not consider de Word of God which teaches in the Gospel that "One should firstly seek the Kingdom of God and His righteousness and then, he will additionally receive the other all things".

But this nature of man is not at all strange to God, Who has long ago foreseen the in the last days men will become "lovers of themselves, lovers of money, they will be boastful, proud, abusive, unholy, scoffing God, disobedient to their parents and ungrateful and they will consider nothing sacred" God is used with the man to disregard his gifts and values, like His creation, with all nature, clean waters, forests, or disregarding His Laws and teachings.

Man has abundantly benefited of the mercy of God so far, but His long patience seems to come to an end. One can clearly see this when one looks around to the



disasters in climate caused by the foolish actions of man in the last decades. Although man claims to be intelligent his actions are clearly proving the opposite.

God also foretells the end of humanity, saying that then it will be like in the days of Noah, “when people were eating and drinking, they got married, until the flood unexpectedly came and took them all...”. Although God offers man not only the example of the Flood, but also the example of Sodom and Gomorra, proving that He is serious in keeping His promises, people are further recklessly acting with regard to their home planet, over abusing the long patience and the mercy of God.

Fact is man is always unhappy and unsatisfied with whatever he has. As already told before, man is the cause for all the imbalances caused by him in Nature. But nonetheless, when the weather is hot he wishes to be cool when it is cool he wants it to be warm, when it is drought he wishes rain and when it rains he wants sun. When God gives him curly or wavy hair, he respectively she wants straight hair, when He gives him/her straight hair, he/she wants wavy or curly hair. Or more generally, when God gives man a certain physical trait, he almost always wants the opposite of what he has received from God.

Instead of treasuring the marvelous gift of God which is the nature with forests, clean waters and clean air, and its landscapes of unspeakable beauty, man has almost completely robbed and destroyed all these gifts, with the purpose to build monstrous ugly cities of grey blocks and weird villas and to spoil all these riches with the purpose of self-satisfying his small wishes.

The response of God to all these caprices of man begins lately to be more and more obvious and also proportional, by comparison with what happened in the past. This is to be explained rather straightforward: when man was humble and put his thrust in God, He chose not to punish him too harsh.

Now, when man claims to be wise, all-knowing, intelligent and independent of God, God shows less and less mercy and punishes man and at the same time shows him how weak he is and how insufficient his science and knowledge is to solve the issues he generated by himself. So, God gives man almost concomitantly sun and shadow, storm and heat and so others, and He thus punishes the infatuation, insolence and the conceit of man.

The only way to solve these issues of us, as well our issues with God is to show temperance in our wishes and our requirements to Him. God teaches us and requests temperance in our wishes and in almost all aspects of life such as it is written in His Word. This kind of temperance in our wishes and requirements is very similar and can be easily assimilated to the fighting of greed. Man however shows incapacity to understand and chooses not to listen and obey the message of God regarding the temperance.

Hence, all what happens around us regarding the environment and climate change is only the outcome of the man’s greed and of his disobedience to his Creator.

According to paper [1], one paramount error of man is that he has “forgotten that God’s love is unconditional and that it applies to all creatures, not just to humans”. Modern man, although often times a non-believer, thinks about himself as being the pinnacle and the master of all God’s creation and that the entire love of God refers only to him.

Man likes to consume and to possess things, to be well viewed in the eyes of the others and to enjoy life in general by owing and using things. But in the Gospel God instructs by mean of His Son: “Strive to enter through the narrow door, because many, I tell you, will try to enter and will not be able to”

God also instructs us: “Never think yourself to be above your brother and thank God for all His blessings”. In the light of later climate changes we should always think to our brothers in poor African countries lacking water for survival.

We should thank God for His blessings and every time when we waste little water we should think to our African brothers who do not have enough drinking water, every time when we go satiated to bed we should think about the millions of children not having enough food. We should be aware of all these, but also of the fact the man has the capacity and ability to change only under pressure, in crises and in very critical circumstances, such as the pressure and the crisis caused by the climate change, wars and pandemics.

There is also an African proverb, this poorest of the planet’s continents which has people who do not only not consume enough, but most of them are even starving to death and this proverb is saying: “The last bird which will fly will know”. This wise proverb could also be interpreted as instructing us that we and all creation in its dying phase will eventually become aware of all evil that has been done to it by man. Man should also realize that he has failed in his mission to be a good steward of Earth and of the gifts he received from God

F. Dostojewski affirms: “*People are unhappy because they do not know that they are happy*”. Until very recently, without wars, without pandemics, without climate or economic crises, people were happy but they did not know that they were happy. As wars, sanitary, economic and climate crises extend and deepen, man is increasingly realize his past happiness.

Despite all these, man should also realize that perhaps today is the moment to be happy, because future may come together with more crises. He also should realize that he should not base his happiness on the goods or services he consumes.

Also, realizing that life comes to an end and moreover, recently realizing that life is both, precious and uncertain, means that there are more chances for people to undone and repair the evil they did to their home planet.



We are taught since the very early childhood, from stories and fairy tales about the Christian values and virtues, like goodness and diligence. Though, the reckless, rebellious and disobedient nature of man almost always chooses the wrong path. Each and every true Christian should admit in his own heart “The good which I want to do, I do not do, and the evil which I do not want to do, I do”.

Although God is expecting us to be faithful believers, one main idea related to faith is the relationship between Christian faith and theology. In his book [2], [6], S. Butler affirms: “*Every time we pronounce the word theology, our sense about Divine suffers*”

This is the exact perspective which Jesus had regarding the teachings of Pharisees and scholars when He said to them: “You are cleaning the outside of the vessel but not its inside...you are like graves which are white and clean outside but rotten inside”. God is not expecting us to praise Him with our mouth, but He is expecting us to go to go to action and to repair the evil we have done to our planet.

“Science without religion is blind, religion without science is crippled”. Consequently, man should ask with more faith for more science from his Creator, in order to solve those imperative issues, regarding environment, climate and resources, he faces today.

All too often our God is in the position presented in the Alan Parsons Project’ composition, “The Eye in the sky”. He is a “Maker of rules, dealing with fools”. Although God gave man the Set of rules he should have necessarily obeyed, man constantly and continuously has chosen to disobey and to defy God.

Man failed in almost all the commands God gave him, but his failing in the mission God gave him to be a good keeper of all God’s creation, has in the present almost brought him on the brink of the extinction disaster. Some “researcher” however, still contest or doubt that man has caused the present day imbalance and they “document” various other stupid causes.

This denial of some so called “researchers”, seem to be the greatest offense brought to the Creator, since by propagating their falsehoods, they are also manipulating a great deal of people who are ready to believe their “theses”.

So, even though there are irrefutable facts and almost no secrets regarding the desirable actions of man, man almost always chooses not to do them. Exactly like this also happens with the actions of man regarding pollution, deforestation, overuse of resources a.s.o. which led to the present climate issues.

After so many mistakes throughout our history, man should at least possess the fisherman’s wisdom. The fisherman knows that his fishing success depends upon weather conditions, the location of fish and also on the fishing skills he possess. In the very same way, man should understand that the present climate crisis situation

and the technology he possess could help him to prevent much greater future disasters.

Man also should ask himself: Is wealth, consume and consumerism with all their consequences for man and planet, all there is? Regarding this question, we should ask for more wisdom. King Solomon asked God for wisdom and he received richness besides. Man should also ask for more wisdom from God, in order to solve these complicate climate issues, because he has already proved that he cannot do this by himself, without help.

“Reason without the correction of instinct is as bad as instinct not corrected by reason”, according to [6]. Although both, our instinct and our reason is telling man that is time to seriously act, with regard to climate, man still postpones serious actions and measures.

Since ages now, man is constantly and continuously questioning the truths, the laws and the teachings of God, putting his own thinking, knowledge and science above, [3], [4], [5]. The present climate disaster we are all facing, however, is proof enough of the foolishness of man.

As it was already mentioned, in seeing happiness by fulfilling his own wishes, the “modern educated” man has developed a consumer behavior which excessively overuses the resources of the planet and deprives the poorer populations of essential indispensable resources for their life.

Besides that, consumerism has also led to the present environmental and climate disaster, mainly and merely because of the “wishes” and not of the “needs” of those “civilized” populations, wanting to fulfil their stupid and selfish desire for happiness.

This is also related to some famous western philosophies which are stating “the pursuit of happiness”. People often see this search of happiness as a function of their fulfilled wishes and of the “richness” of their possessions.

According to the Goshen’s laws, “Consumers’ satisfaction will decrease as their needs are met constantly” and “Consumers will continue to meet their needs until they reach the same intensity”. One can conclude out of these two laws that, on one hand consume is an addiction and on the other hand that in order to stay constantly happy, the consumer has to permanently consume increasingly more.

This consequence of the Goshen’s laws is also the explanation for the present situation of the pollution caused by man consuming permanently more and more goods, polluting water and air with more and more plastic packages and exhaust gases, cutting more and more forests, using more and more fertilizers and thus polluting the soil, eating and destroying entire ecosystems, all this for his “so called” happiness.

3. SOLUTIONS TO PROBLEMS CREATED BY HUMAN “PURSUIT OF HAPPINESS”



One can begin to tackle these complicate issues regarding the exaggerated consume and the overuse of resources, starting from determining the causes, reasons and explanations for these problems.

3.1 *Explanations for the exaggerated consume, consumerism and the overuse of resources*

There are a few theories explaining consumer's behavior. These theories are based on incentive motivation, drive reinforcement, theory of microeconomics, psychological theories regarding the action of environment and society on individuals. All these motivations are more or less related with the happiness of man being satisfied by his consume and being seen as "integrated" in society or having a recognized status in the respective society.

This buying and consume attitude of the modern man has been fired up, with the purpose of boosting economy, by some "intelligent" actions in the western society, such as fashion, publicity and availability of the credit. People were taught by means of publicity that they should be fashionable in order to be successful and the means to buy and consume were largely provided by huge amounts of available credits.

Slowly but surely, these actions have been and still today are embedded in the DNA of the populations brainwashed by the respective publicity stimulating consume and consumerism.

Beside this ordinary manipulation regarding the fact that if you are not fashionable you are almost nothing worth, the manipulation that by consuming a lot you are a good citizen which helps growing the economy was also added to this model. People were taught that consume is the engine of economy and development.

3.2 *Solutions to fight the exaggerated consume, consumerism and the overuse of resources*

Nowadays, more than ever, although the Earth's resources become more and more scarce, people often buy and consume huge quantities of goods and food, in order to be "happier". Although those good are named "of long term use", some of the respective goods are not durable at all anymore and when they are broken, people immediately replace them with "better, more performing new ones".

The quantity of food which is thrown away is bigger than ever before and this happens when huge populations are starving in the poor countries. As the resource and climate crises install, man should revert to his old healthy habits from the past, when long term use goods (and not only these, but also textiles, clothes a.s.o.) were repaired, restored and refurbished, but not thrown away.

Often times, such recycled equipment is by far much more durable than new bought equipment which is

often designed and made to be replaced after the expiration of its warranty.

Thus, before it is too late to repair the evil which has been already done, man should fight his buying impulses and his consuming habits, because very much of the current situation regarding our planet is due to them.

It is obvious that all humanity crises we find ourselves in, climate, environment and resource crises have been caused by this greedy, excessive and irrational consumption of man who is searching his happiness in new more and more buying of every type.

Some important ideas and solutions against consume and consumerism, have in the meantime already occurred. It was only very much later when some realized deep and hurting truths such as: "with money they do not have, people buy things they do not need to impress other people who do not care about them...".

Other ideas are related to the fact that resources are extremely valuable and recycling of materials, design of the products in such way that they can be more easily split into components, car sharing or using the bus instead of using the own car, rational consumption or even minimalist living are already gaining huge popularity.

But although these ideas exist and almost everybody knows them, they are put in action rather delayed because of people's resistance and because of people still not yet understanding the urgency to act now.

The electric car is one of the best examples for such human indolence, foolishness and rational economic "thinking". Electric cars were invented almost concomitantly with those with internal combustion. Only human stubbornness, stupidity and the man's greed for profits have delayed development and use of electric cars meant to replace those using fossil fuels.

On the other hand, brilliant inventors like Nikola Tesla, preoccupied, interested and committed to offer inventions providing almost free electric energy, died and have been buried along with their inventions which could have surely prevented the serious climate issues from today.

Now reverting to the consume and the consumerism embedded in the genes of modern humans, the facts presented above are, as one can see, related with the science of epigenetics, when under the influences of behavior of parents and fashion in society, this information regarding the consume behavior is embedded in the epigenetic DNA code of the people.

Luckily, as one already knows, unlike pure genetic modifications which are rather irreversible, the epigenetic modifications in DNA are reversible. It is up to the man to restore former values like repairing, refurbishing, reusing and recycling of goods which may be saved and to consciously and contrary act against the damaging behavior of consumerism.

It is also already known fact that genetic engineering is so advanced these days, fact also proven



by the success of the RNA messenger vaccines, which were, as it is well known, very successfully in fighting the Corona virus pandemics.

If only awareness and consciousness regarding the necessary actions needed is not enough, the genetic engineering which is very advanced at this moment, could perhaps provide a vaccine against this deadly virus of human behavior, which will eventually cause its own extinction.

A very good idea would probably be to remove those bad and faulty consume genes from the epigenetic of the modern man, using such advanced vaccine, using gene tech such as the genetic engineering using CRISPR to cut out these faulty genes in populations. It is also well known that in epigenetics such faulty or poor genes in people, causing consumerism and consume could be repaired, and thus the behavior of man, changed for the good.

This chain of thoughts can also be brought into a relationship with a known hypothesis issued some time ago already, namely that humans are the real virus to threaten life on Earth, after all.

Making the connection with the thoughts above about epigenetics and perhaps using appropriate genetic engineering, this virus could be most probably rendered inoffensive, by eliminating these faulty genes of consume and consumerism which were previously, in the past, so much trained and overstimulated and now are so present in humans.

If man was so successful in brainwashing people and convincing them that consume is a good thing which brings a lot of happiness, and theories were created and successfully used in that sense, perhaps man should now, in the last hour, do the opposite of the means used by those theories.

Also, if man does not have the capacity to understand that he has harmed his home and himself, another idea would be to use incentives for those consuming less or to introduce harsh punishments for consume actions which were previously rewarded with incentives.

For generations now, people have been taught that is a must not only to be fashionable as presented in the advertising commercials but it is also a must have to have credits at banks in order to pay for those fashionable ideas presented by the publicity. Moreover, people have been also taught that if they have credits and if they consume, they are good citizens helping their national economies and implicitly them to thrive.

Now, both, this ideology and this philosophy, on which until very soon the entire human behavior were based, have not only proven their limitations but also show that when societies are more interested in profit and in short term wellbeing of their economies, on the long term, disaster is at horizon for the entire planet.

The “educated” man is most commonly a nonbeliever. He only judges and acts based on facts. So, in his infinite mercy and long patience, God gives him

some facts: “See the garbage and the pollution you have made and the temperatures rising caused. See that the polar ice caps melting, see the deforestations of entire mountains and see more and more storms, floods, hurricanes, droughts on planet. See snow where previously used not to be and see desert temperatures where there was cool. Get yourself some facts, according to your boastful human science!”.

But man, in his huge wisdom still analyses and researches about possible causes of this phenomena: “It may be cyclical phenomena in nature, it may be the activity of a hotter sun, some identical warming has already happened on Earth and these all are usual phenomena which happen periodically. Let us see what more it will happen in the future in order to gather more data to be analyzed...Let us see whether finally we all will be killed in short time by our stupidity...”

Some other so called “specialists” also even come with stupid arguments regarding the lack of some resources, saying, for example, that certain birds which are eating fish are responsible for the present day lack of fish in the waters, and not the overfishing without any imposed limits.

The ultimate lesson which God gives man is “Look, you put your faith in and you trusted your own human logic and your narrow rationalism, intelligence and science, and see for yourself all the evil and all the disaster you have caused on and to your planet. How much did it help your science and your intelligence? You have seen all the signs and results of your own foolish actions, you have seen the climate worsening from year to year and what have you done against this? What was your “claimed” intelligence and science good for?”

Although the need for food and aliments for an increasing Earth’s population is higher than ever, man intentionally reduces the crop cultures which are comestible, by only selecting few comestible plants, out of the many crops intended and provided by God to feed us.

This is again a situation when man refuses the gifts and the help of God, simply out of economic reasons, because some cultures are more profitable than others. This decrease of biodiversity caused by man has serious long term implications for the health of people. But again “the rational man” is acting only based on profit reasons.

4. CONCLUSIONS

As soon as possible, in order to survive, man should realize the damage and the disaster he himself brought on his home planet. In order to solve his issues, man should firstly be aware of what he became, he must change his damaging consumerism and his ways of being happy, and then secondly, he should find and apply practical and technical solutions to repair all the evil which he has done so far.



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RELIGIOUS BELIEF, SCIENTIFIC REASONING AND ABILITY OF MAN TO SOLVE CLIMATE AND ENVIRONMENT ISSUES

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Abstract: This paper presents the main complicate science issues man has to solve, but it also presents reasons to explain his present incapacity to solve them. It also shows ways to address more successfully those complicate issues, in order to find their solutions.

Key words: climate issues, quantum phenomena, accidents, faith.

1. INTRODUCTION

The roots of understanding complicate science issues like quantum physics, may be surprisingly found, according to [1] in the ancient logic.

The present paper also gives explanations for the existence of the “quantum” logic and for the non-necessity of time existence in the realm of quantum phenomena. It also identifies the human infatuation as the main culprit for the incapacity of man to solve these complicate issues.

Approaching the unknown and the big issues with humbleness and modesty, may be the best possible way to solve these problems man faces today.

2. QUANTUM PHYSICS AND QUANTUM LOGIC

Although often disregarded or considered to be primitive in thinking, according to the History of Logic [1], ancient people may have had a kind of logic and a type of philosophy which may have permitted them much more easily, despite of their primitive thinking, to feel and understand the very abstract ideas of the quantum logic.

This fact is also taking us back to another moment in the history of mankind, namely in the late Middle Age, when during the Renaissance, after the Dark Middle Age, people firmly believed that science and arts in the ancient times of the Antiquity were far more advanced than in the time of the Middle Age. They then hardly tried to restore and to reconstruct science, arts and knowledge which was available thousand years before their time.

We also often times tend to think that our primitive ancestors were not so clever as we are, but we also often forget that not only they created and used high

performance tools and weapons, sometimes far more advanced than what the modern man can create, but they also often times had skills and abilities allowing them to survive in harsh conditions, which are now long time lost and not available anymore.

For example, the so called “Participation law” [1], pag.26, by which a man pretends to be at the same time also another entity, which is not based on “classical” principles of logic, such as identity or contradiction principles is very related with the “quantum logic” where, at the same time, a particle exist and does not exist. It seems that the absence of the basis of the modern logic could have made ancient people to have more affinities with the quantum phenomena, than the educated modern man.

Also according to [1], (page 27), this functioning way of the primitive mentality has been named “fore logic” by Levy Bruhl. Bruhl also not affirms that the “fore logic” mentality is inferior to the mentality of the modern man, but he only affirms that this mentality is only oriented in another sense.

On the other hand all researchers of the human logic have agreed that the primitive people had extraordinary intellectual abilities: “their memory was extremely good and sometimes their ability to distinguish was far more superior that that of the civilized man”. [1], pag.27.

According to the same book [1], the language of primitives, which is a tool expressing their logic comprises a variety of nuances for expressing different or slightly different things and details. Some of these rules are to be found also in a great variety of modern languages. For example, in German one uses the verb “gehen” for on foot movement and “fahren” for the move using a vehicle, or “stehen” for vertically position and “liegen” for horizontal position, *a.s.o.*, and such example can also be found in other modern languages,

which is proof that some portion of those “primitive” language and abilities have been transmitted from our ancestors to us, over multiple generations.

Another section in the same book [1], pag.62, is addressing the polyvalent logic, wherein neither the excluded third party principle, nor the contradiction principle are universally valid, exactly like in the case of the “quantum” logic.

Going further to the Indian philosophy, according to the same book [1], pag.70, Sriharsa’s purpose in one of his works was to show that one cannot affirm whether a thing exists or does not exist, by showing that no proof is good enough to resist when examined by reason. This is also exactly what happens in the realm of quantum physics, and again, perhaps this Indian philosopher living thousand year ago, was better prepared than the modern man to understand quantum physics.

A further ultimate argument for the superiority of the ancient science, logic and thinking can be found in the work of Abel Ray [4], where it says “While the Orient has founded a science which could become our science in the future, Ionia founded a science which became our European science, our intellectual civilization...”

In his book, *The Karamazov Brothers*, using the very same “quantum logic”, F. M. Dostojewski writes: “If God does not exist, anything could be possible”. Deep down at the quantum level, where according to quantum physics almost anything is possible, or in some societies which do not recognize and do not believe in God, anything may be possible because there is no need for God.

A second explanation for the non-necessity of God’s existence at quantum level is that, since at the quantum level there is no evil, there is also no need for God’s intervention at the level of the quantum world.

A third explanation for the existence of a “quantum logic” refers to the pride and the conceit of man. When man thought himself almost in complete control and thought that his intelligence and reason are sufficient and able to explain everything, thinking about the fact that the presence of God is not necessary anymore, God prepared him a big surprise deep down at quantum level, as if to tell him: “Look how small you are and look how small and limited your praised intelligence, knowledge and science is, because you understand almost nothing of what happens at the quantum level!”

This way, the existence of quantum physics and of the related quantum phenomena, also becomes an additional evidence for the existence of God, an evidence which should humble us before the Creation we barely seem to understand. It is as if God will tell us: “Man, you are so small and so irrational to Me, as small and irrational as quantum phenomena seem to yourself, because all your actions related to My creation are so foolish and irrational and they almost all against their Creator, His creation and ultimately against this small proportion of creation which is man himself”.

3. THE HUMAN INCAPACITY TO SOLVE COMPLICATE ISSUES

Until the climate and environmental issues become serious and dangerous, also the godless western society has not taken God seriously, with disastrous consequences for the health of our planet. Now, the civilized western society, forced by the consequences of its own actions, is going back to God and hardly tries to repair the evil already done to the environment of the planet.

3.1 *Reasons for the human incapacity to solve complicate issues*

Regarding the understanding of the quantum phenomena, it may very well be that the actual human faith is by far not mature and not strong enough to allow the understanding of this quantum logic. On one hand, down at the quantum level, where consciousness does not exist, being no need for God or God’s intervention, realities at the quantum level contradict the usual common human logic.

On the other hand, God may be perhaps very unsatisfied with the human infatuation of the modern man and He puzzles him with this kind of logic, to which the ancient Chinese sophists were pretty very well used to. According to those Chinese sophists, as in [1], “A white horse is not a horse”. And different similar ideas contrary to human logic may be simultaneously be true, exactly like in the case of quantum physics.

Regarding the issues the man is facing in not understanding certain facts of phenomena in science, this fact may also very well imply that God does not want to reveal Himself to those not believing in Him. He tells us: “Behold, I am standing in front of the door and I knock, If somebody hears My voice and opens the door, I enter and I dine with him”. Logos and hence logic, in the usual meaning, does not exist in the absence of God or without believing in God.

God never tires to call for those who want to obey Him, but those not responding and not opening the door, God will harden their hearts, meaning that God will not reveal Himself to the persistent nonbeliever.

In order to address certain complicate science issues, such as the climate issues have also become, one should think outside the box, that is to say one should tackle the respective problem in a scientific manner, but preferably without using classical known science. In this way, using science from outside the realm of the known scientific knowledge, man extends his scientific knowledge and increases his chances so solve the respective scientific problem, as well.

The above statement somehow sustains the opinion of some nonbelievers. According to those, in order to solve the intricate issue of proper moral and ethical behaviour, man created certain instruments such as religion is. In their view, God and religion are simply human inventions, designed for ethical and moral



purposes. In their opinion, such ethical and moral reasons, would only represent laws and rules for peaceful coexistence between people and are strongly related with the concept of conscience.

Often times, instead of simply obeying God and His rules and instructions, in his vanity, man tries to express those rules and laws set by God in a much more complicated manner and in a sophisticated language. This not only shows an example of bad science, which is science expressed in much more words than is necessary, but also shows the disobedience and the arrogance of man.

For example, Lord says “The vengeance is mine”, whereas the German language speaker say “Die Rache ist suess” (“*Revenge is sweet*”).

God basic instruction: “Do not rely on your own wisdom” is translated by man in peculiar long savant statements, as follows: “Man as decision subject is rationally limited because: he is only incompletely and poorly informed about relevant decision situation, he does not know all the actions alternatives, he only has incomplete information about his own goals, he can hardly assign unique consequences and results to his own action alternatives and he only possesses limited information processing capability”

Another example for expressing the same idea above, namely “Do not rely on your own wisdom” is according to Silberer (1979, p.50). In the same complicated and savant manner, two basis axioms explain the human behaviour, namely: The gratification principle and the capacity principle. The gratification principle after Silberer is stated as follows: “The gratification principle is a psychologized rational principle which states that the man strives for reward and, at the same time, seek to avoid punishment”. The capacity principle refers to the limited information processing capacity of man, namely stating that man lacks the capacity to assess which of his actions will lead to a reward or to a punishment”, according to [5].

Another example when man is twisting and changing the words of God is the expression “*Ad augusta per angusta*”, which is to find in the Gospel, in the form expressed by God: “Strive to enter through the narrow gate...”

These “reformulations” expressed by man in savant complicated manners even contradict science principles of man, for example the Occam’s razor principle which states: “Always prefer the simplest alternative/hypothesis against the other more complicated ones”. It seems that expression often used by man “Less is more” applies only when suitable for man.

With regard to the environment and climate change, man almost always preferred the complicated explanations and theories, that is to say he refused to admit that these changes are caused by his own silly actions. Regarding these facts he seeks other explanations, denying the obvious causes.

So, one can see a pattern is emerging here, man manipulating not only formulations, science and facts,

but also often denying evidences as it pleases him and as it suits him for his own small human purposes.

There are also those unbelievers who, although they are denying the existence of God, are not very comfortable with the idea that they are simply nothing more than evolved apes.

3.2 Possible approaches to solve complicate issues

The best possible approach to solve those complicated issues human civilization faces in the present, is to address them with humbleness and modesty and may be then God, in His mercy, will turn His face to us and will eventually help us.

God not only uses the time dimension as a parameter to solve problems in the normal scale conscious world, but through existence of time, it also gives man an opportunity to address and to solve his issues. Man however, often disregards this chance from God, exactly like in the case of climate and environment issues, and in this way, the time of grace remained to solve these intricate issues is shorter and shorter and it also becomes more and more expensive. This fact, is also a reason and an explanation of non-necessity of the concept of time at the level of the unconscious world of small scale phenomena.

One cannot refute the fact that the plan of God always fulfils, disregarding all circumstances: will of man, wars, earthquakes or even alien intervention. God is always on the move and we can find His intervention in the “accidents” and in the “random incidents” happening in science.

At a regular basis, from time to time, we encounter in the scientific world expressions such as: “**Accidentally**, researchers have discovered that electric batteries/ accumulators are charging faster at higher temperatures”, “**Accidentally**, researchers have discovered that light increases the production of hydrogen”. Our God is always on the move and is not “accidentally” helping us to overcome the obstacles we encounter to solve the issues we ourselves generated, in order to make things right again.

Otherwise, if this creature named man has “accidentally” evolved long time ago from a certain ape, may also very well “accidentally” disappear, as it never existed. Moreover, the name creature, which has never been abolished and which man uses with regard to all plants and animal, is proof again that at his “subconscious” level, man always admit the all there is, is part of what the Creator has created.

These numerous “accidents” above in science are related to the well-known fact that when you set yourself a noble goal or you altruistically want to solve a certain problem, the whole Universe entirely conspires in helping you to solve the respective problem. That is to say, if this certain problem to be solved regards the benefit and the wellbeing of a lot of people, Universe will multiplied conspire to help you with the solution to that particular problem. The alternative of this idea

before, for non-believers, may sound approximately like this: “When you tell your brain to look for something, your brain will find it for you”. In the same way, when you tell your brain to wake you up in the morning, usually it will”

Other possible solutions for such complicate issues, like the climate issues and their consequences, could come from the so praise artificial intelligence. Instead of regarding A.I. as a threat for man and for the human civilization, as it is often times speculated, instead of using A.I. for surveillance and commercial purposes, if we are smart enough not to destroy ourselves until then, perhaps a sufficiently evolved A.I. could really help us to solve such complicate survival issues, like the climate issues are, for instance.

Another puzzling contradiction with regard to the relationship between religious/moral belief and the scientific reasoning or “usual logic” is to be encountered in the present and in the past as well. Why would anyone (for example whistle blowers like J. Assange or E. Snowden) risk their own life for the sake of one idea or for an ideal? This makes not very much sense for an “usual thinking man”. Moreover, what is the “human logic” in the fact that Jesus freely gave His life for the benefit of all human kind? Some are using technology against evil doings of governments and agencies or other state institutions trying to restrict human rights and freedom with the excuse for a safer world, risking their lives like martyrs for an idea and ideals like freedom. Others, on the other side, use technology for organized crimes like in the famous case of EncroChat. World’s governments and agencies should regain the thrust of people by using their resources not to control and survey all their populations under the false pretext of safety, but they rather should surgically extract and remove the evil doers, without menacing and restricting intimacy and freedoms of people.

In accordance with [6], “The only way one can see into the future (and solve present issues) is by understanding the truths of the past. Man truly uses all his available resources only when he knows that future turns against him if he does not take the compulsory actions”

4. CONCLUSIONS

Admit our human limits and our incapacity to solve serious issues, some of them even regarding our very own survival, thrust God, respect His creation, see His intervention everywhere in our lives, ask

Him for help with modesty and humbleness and perhaps we may still have a chance to survive.

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FTA ON SHIP FIREFIGHTING PLANT

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Abstract : One of the main causes of accidents on board ships is fire. This is because of the presence of high temperature, the excess quantity of flammable oil and other combustible materials. A ship is fitted with various types of fire retardant and firefighting equipment so as to fight any kind of fire and extinguish it as soon as possible before it turns into a major catastrophic situation. *Purpose*: This paper presents the crisis management on ship's firefighting plant, Technical data for firefighting plant with foam, Fault Tree Analysis data, Fault tree block diagram, Failure probability and basic events of fault tree, The equations of fire analysis, The method of simulation, The simulation of a fire incident in the firefighting plant, for a ship named "Mamola Defender" which is a vessel that provides the supply of marine drilling platforms. *The results* are: Foam firefighting plant diagram, Locations for firefighting systems, Fire Control and Safety Plans, Fault tree block diagram, The values of probabilities, The relationship between input and output events. *The results* of simulation for a scenario are: radiant heat distribution of a jet fire, the heat flux, the temperature distribution on different stage of fire, the flame propagations. *Conclusions*: The methods which used for simulation present a possible fire incident in a plant with many hazardous materials. This method of simulation is useful to assistance plant owners and operators in different events of emergency situations. This methodology is useful to prevent human casualties and important structures.

Key words: Fault tree analysis, fire, vessel, simulation, crisis, management, hazardous, heat.

1. INTRODUCTION

One of the main causes of accidents on board ships is fire. This is because of the presence of high temperature, the excess quantity of flammable oil and other combustible materials. A ship is fitted with various types of fire retardant and firefighting equipment so as to fight any kind of fire and extinguish it as soon as possible before it turns into a major catastrophic situation.

“ A ship is approved to sail in international waters only if it is constructed as per the Fire Safety System code and carries required Fire Fighting Appliances approved by the concerned authority” [1].

“ A ship is fitted with various types of fire retardant and firefighting equipment so as to fight any kind of fire and extinguish it as soon as possible before it turns into a major catastrophic situation” [1].

The firefighting equipment which are used on board ships are: Fire Retardant Bulkhead, Fire doors, Fire Dampers, Fire Pumps, Fire Main Piping and Valves, Fire Hose and Nozzles, Fire Hydrants, Portable Fire Extinguishers, Fixed Fire extinguishing system, Inert Gas System, Fire Detectors and Alarms, Remote Shut

and Stop System, EEBD: EEBD (Emergency Escape Breathing Device), Fire Fighter's Outfit, International Shore Connection (ISC), Means of Escape, etc.

This paper presents the crisis management on ship's firefighting plant, Technical data for firefighting plant with foam, Fault Tree Analysis data, Fault tree block diagram, Failure probability and basic events of fault tree, The equations of fire analysis, The method of simulation, The simulation of a fire incident in the firefighting plant, for a ship named "Mamola Defender" which is a vessel that provides the supply of marine drilling platforms.

2. FAULT TREE ANALYSIS ON SHIP FIRE FIGHTING PLANT

2.1 Choice of study vessel :

A ship is fitted with various types of fire retardant and firefighting equipment so as to fight any kind of fire and extinguish it as soon as possible before it turns into a major catastrophic situation

The ship "Mamola Defender" is a vessel that provides the supply of marine drilling platforms (Figure 1) [2].



Figure 1 The ship "Mamola Defender" [2]

This ship transports various goods: fuel, potable water, brine, cement, bar, drilling mud, drilling poles, etc. and crews. The ship may carry on deck and conventional containers for various goods. The ship can also operate as a fire extinguisher at marine platforms and is equipped with marine pollution equipment.

Ship characteristics:

The ship has a total length of $L = 80$ m, a weight of $G = 3.300$ T and can reach a speed of $VN = 13.5$ knots.

2.2 *Crisis management on ship's firefighting plant:*

For designing a fire extinguishing installations (Figure 2)[3], it is good to know the importance and compatibility of the extinguishing substances used and the safety and protection of users space.



Figure 2 Local firefighting pumps panel [3]

The pumps which are used on these plants are usually FRAMO pumps (Figure 3) [4].

For this study was chose a fire fighting plant with foam (Figure 4) [4].

The members of crew must fulfilled some requirements (Figure 5) to prevent fire on board (Figure 6)[4].



Figure 3 FRAMO pumps [4]

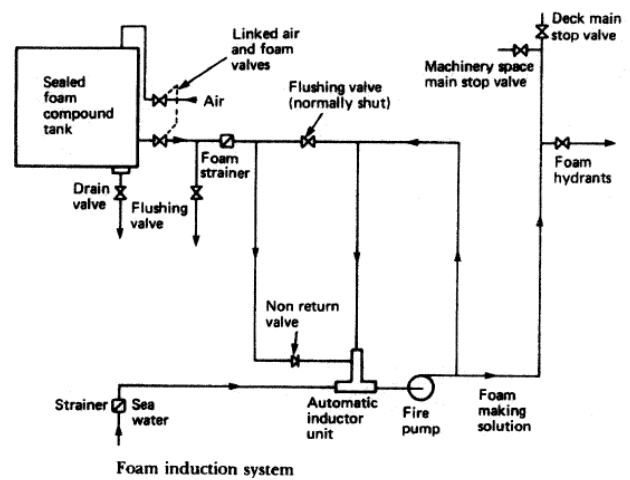


Figure 4 Foam firefighting plant diagram [4]

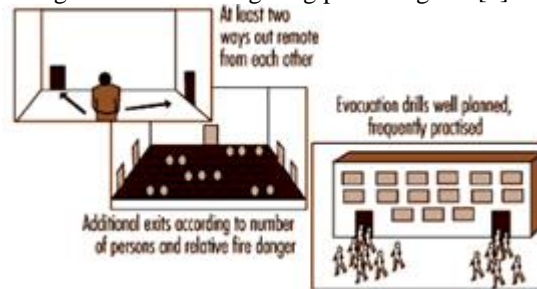


Figure 5 Some requirements for crew [4]

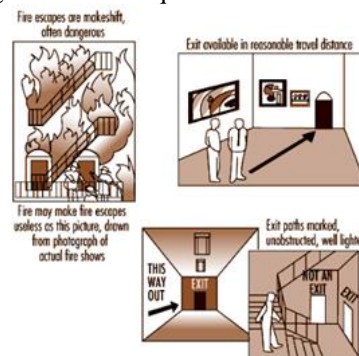


Figure 6 Firefighting requirements for crew [4]

2.3 Technical data for firefighting plant with foam:

On board the firefighting plants are different places for locations (Figure 7) [4].

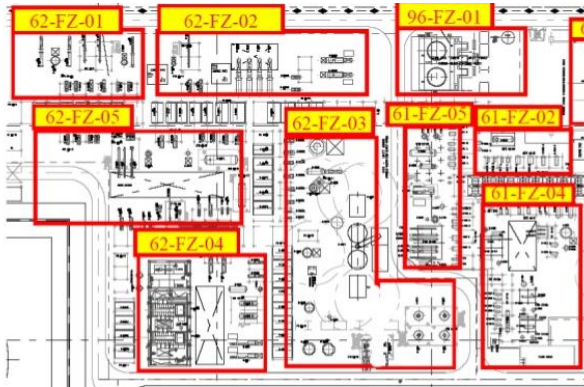


Figure 7 Locations for firefighting systems [4]

2.4 Fault Tree Analysis data

Fault Tree Analysis (FTA) is an efficient and productive hazard identification method [5]. Data requirements:

- A complete understanding of how the plants/system functions (Figure 8);
- Knowledge of the plant/system equipment failure modes and their effects on the plant/System (Figure 9).

Failure Modes Effects and Criticality Analysis (FMECA), offer referred to as FMEA is process analysis that help to identify potential failures of system [5].

2.5 Fault tree block diagram :

The Fault Tree Analysis is an engineering technique for reliability and safety procedures. Fault Tree Diagrams (FTD) are block diagrams which present the status of the system with the states of its components (top event, basic events) [6]. FTD are a graphical design technique (Figure 10) and an alternative methodology to reliability block diagrams -RBDs.

2.6 Failure probability and basic events of fault tree:

Using Boolean logic [33], [34] for event symbols, gate symbols (to describe the relationship between input and output events), transfer symbols (used to connect the inputs and outputs of related fault trees), can evaluate time of good maintenance (λ)(unit-years), the mean times to failure ($MTTF \sim \frac{1}{\lambda}$)(unit-hours/week/month) and failure rate (the probability density function PDF) (Figure 11, Figure 12, Figure 13) [6].

The logical relationships are graphically generated as described below using standardized FTA logic symbols (Figure 12, Figure 13, Figure 14).

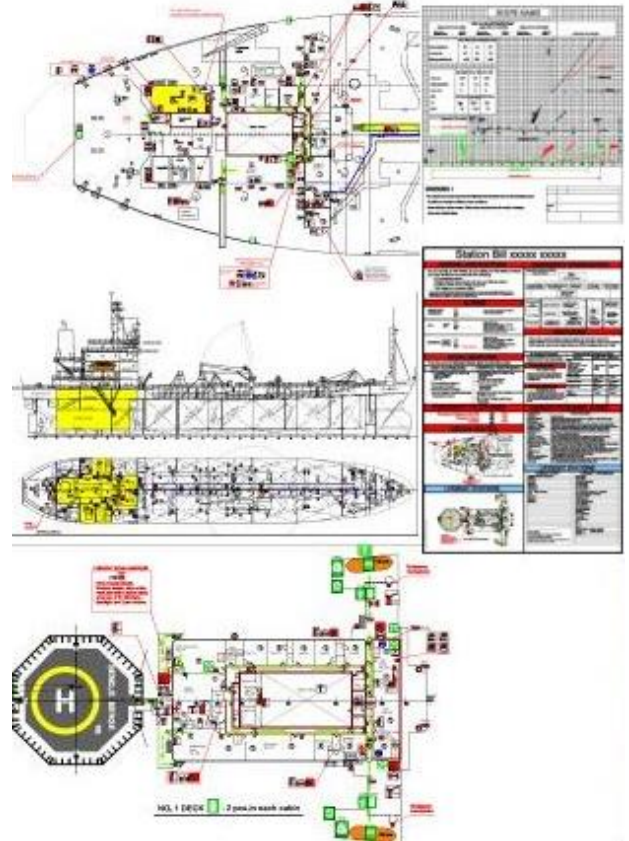


Figure 8 Fire Control and Safety Plans [4]

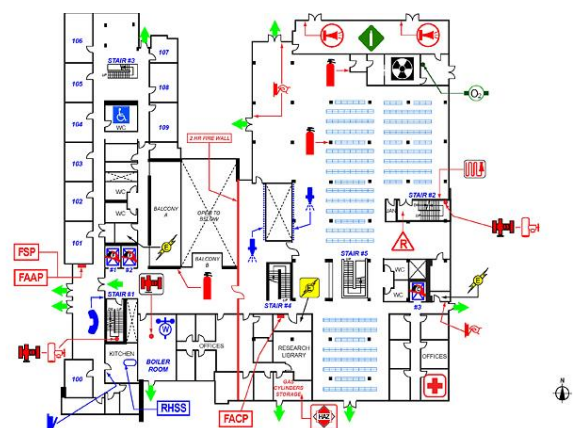


Figure 9 Fire safety plan [4]

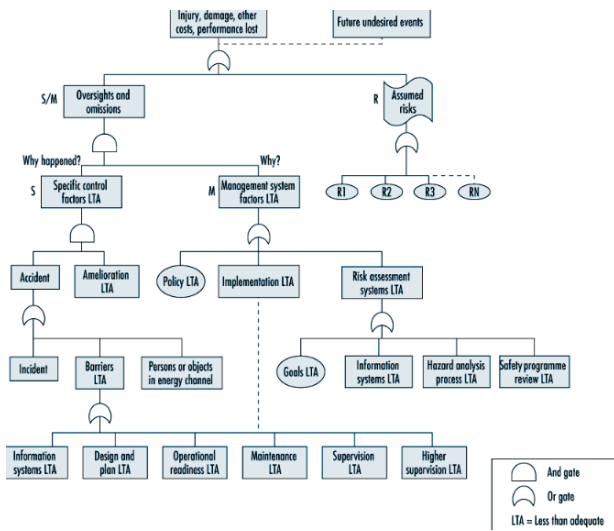


Figure 10 Fault Tree block diagram

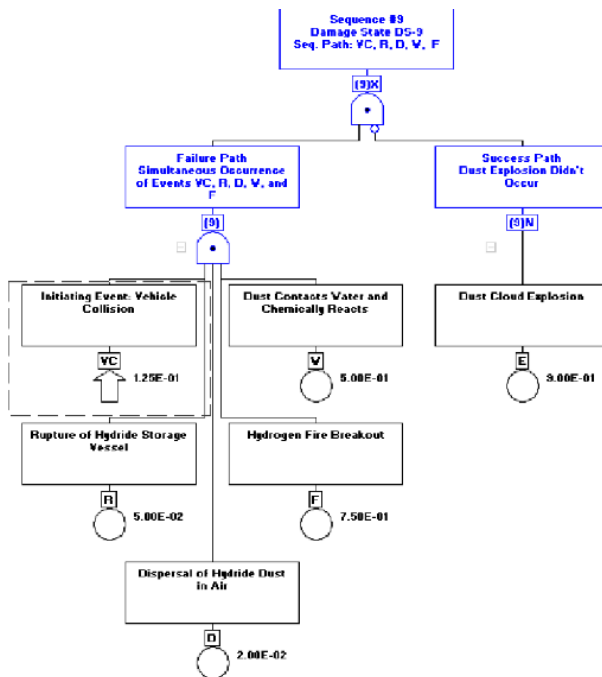


Figure 11 Logic scheme

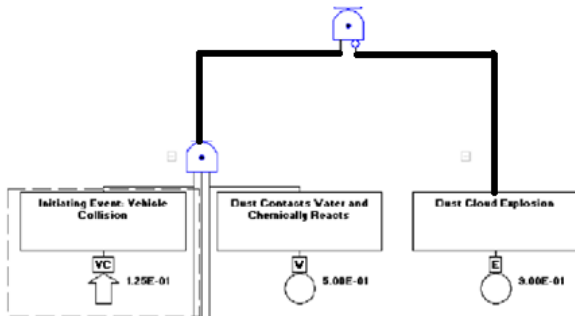


Figure 12 The values of probabilities

Top event is: QTOP = 9.42 * 10⁻²; TOP = 1/10[year].

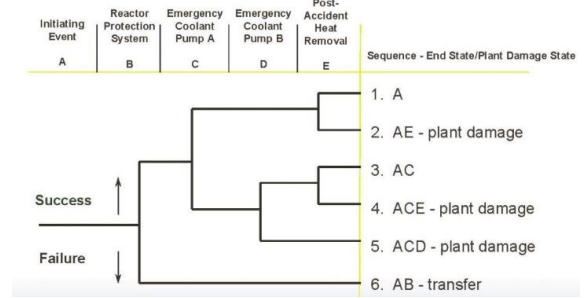


Figure 13 The relationship between input and output events

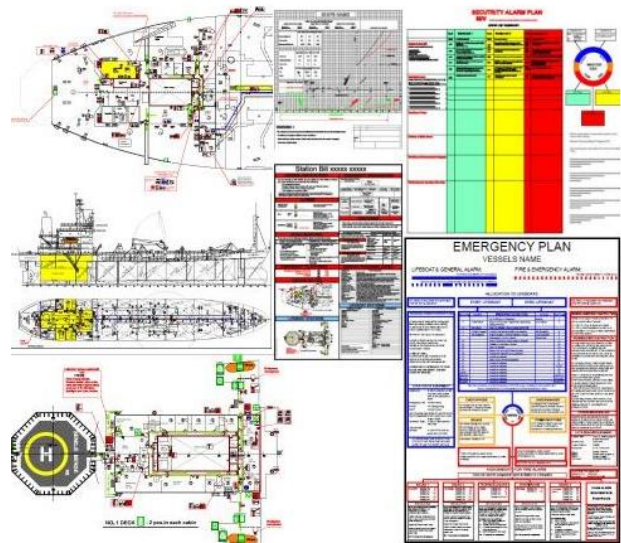


Figure 14 Security and Emergency Plan on the ship

3. THE SIMULATION OF SCENARIO

In the context of recent studies of jet fires numerical analysis it is better to analyse these aspects of fire incidents from the context of simple geometry. For this aspect is not enough study about a simulation of jet fire. It is necessary to analyse all aspects of the combustion and firefighting plant [5].

3.1 The equations of fire analysis :

The equations to analyse the combustion can developed on different simulators [6].

The governing equations of gas combustions are:

-equation of chemical species (1),

$$\frac{\partial \bar{\rho} \tilde{Y}_l}{\partial t} + \frac{\partial \bar{\rho} \tilde{u}_j \tilde{Y}_l}{\partial x_j} = - \frac{\partial}{\partial x_j} (\bar{\rho} \tilde{Y}_l \tilde{V}_{lj}) - \frac{\partial}{\partial x_j} (\bar{\rho} u_j'' \tilde{Y}_l'') + \bar{\rho} \tilde{R}_l + \bar{\rho} \tilde{R}_{li,q}$$

(1)

- continuity equation for mass conservation (2),

$$\frac{\partial \bar{\rho}}{\partial t} + \frac{\partial \bar{\rho} \tilde{u}_j}{\partial x_j} = \bar{\rho} \tilde{R}_{liq} \quad (2)$$

- the equation of momentum -Navies–Stokes equation (3)

$$\frac{\partial \bar{\rho} \tilde{u}_i}{\partial t} + \frac{\partial \bar{\rho} \tilde{u}_j \tilde{u}_i}{\partial x_j} = -\frac{\partial \bar{p}}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\overline{\tau_{ij}} - \overline{\rho u_j'' u_i''} \right) + \bar{\rho} \tilde{f}_i + \bar{\rho} \tilde{F}_{liq,i} \quad (3)$$

- the equation of energy transmission for gas compressed flow (4)

$$\frac{\partial}{\partial t} (\bar{\rho} \tilde{e}_T) + \frac{\partial}{\partial x_j} (\bar{\rho} \tilde{u}_j \tilde{e}_T) = \frac{\partial}{\partial x_j} \left(\overline{(\tau_{ij} - P) u_j} \right) + \frac{\partial}{\partial x_j} \left(k_l \frac{\partial \bar{T}}{\partial x_j} - \bar{\rho} \tilde{u}_j'' \tilde{e}_T'' \right) + \bar{Q}_{gs} + \bar{Q}_{Rad} + \bar{\rho} \tilde{S}_{liq} \quad (4)$$

Where

$$R_{liq} = \sum_l R_{liq,l} \quad (5)$$

$$\overline{\tau_{ij}} = \mu \left(\frac{\partial \tilde{u}_i}{\partial x_j} + \frac{\partial \tilde{u}_j}{\partial x_i} \right) + \left(\kappa - \frac{2}{3} \mu \right) \left(\frac{\partial \tilde{u}_\kappa}{\partial x_\kappa} \right) \delta_{ij} \quad (6)$$

$$e_T = e + \frac{1}{2} \tilde{u}_i \tilde{u}_i \quad (7)$$

$$e = \sum_l Y_l e_l(T) \quad (8)$$

The equations of simulation for this case study were compared with the equation of CFD analytical methodology (the Reynolds averaged Navies–Stokes (RANS)) and with the equation of analytic methods (eq.9- the conventional k-ε equation with k-ε model, eq.10- turbulence kinetic energy with ε for the dissipation ratio) [7]:

$$\frac{\partial (\bar{\rho} k)}{\partial t} + \frac{\partial (\bar{\rho} \tilde{u}_i k)}{\partial x_i} = \frac{\partial}{\partial x_i} \left(\frac{\mu_{eff}}{\sigma_k} \frac{\partial k}{\partial x_i} \right) + P - \bar{\rho} \varepsilon + B \quad (9)$$

$$\frac{\partial (\bar{\rho} \varepsilon)}{\partial t} + \frac{\partial (\bar{\rho} \tilde{u}_i \varepsilon)}{\partial x_i} = \frac{\partial}{\partial x_i} \left(\frac{\mu_{eff}}{\sigma_\varepsilon} \frac{\partial \varepsilon}{\partial x_i} \right) + C_1 f_1 P \frac{\varepsilon}{k} - C_2 f_2 \bar{\rho} \frac{\varepsilon^2}{k} + C_1 C_2 \frac{\varepsilon}{k} B \quad (10)$$

Where

$$P = \bar{\rho} \nu_t \left(\frac{\partial \tilde{u}_i}{\partial x_j} + \frac{\partial \tilde{u}_j}{\partial x_i} \right) \frac{\partial \tilde{u}_j}{\partial x_i} \quad (11)$$

$$B = \bar{\rho} \tilde{u}_i'' \rho'' g_i = -\Gamma_{\rho t} \frac{\partial \bar{\rho}}{\partial x_i} g_i \quad (12)$$

$$\mu_t = C_D f_{\mu} \rho \frac{k^2}{\varepsilon} \quad (13)$$

$$f_u = \exp \left[\frac{-2.5}{1 + R_t/50} \right] \quad (14)$$

$$R_t = \frac{\rho k^2}{\mu \varepsilon} \quad (15)$$

$$\mu_{eff} = \mu_l + \mu_T \quad (16)$$

As a turbulence model coefficient ,

$$C_D = 0.09, \sigma_k = 1.0, \sigma_\varepsilon = 1.3, C_1 = 1.44, C_2 = 1.92.$$

3.2 The method of simulation:

To analyse the combustion we have used the K.F.X. Simulator (Kemeleon FireEx, Norway, Trondheim)[36].

The simulator prepares a network in a 3D space and applies a F.E.M. with finite volumes to analyse the flow of fluid in OXYZ axes.

3.3 The simulation of a fire incident in the firefighting plant:

The plant has a complex structure with many pipes and pumps pressure for fluids (Figure 15).

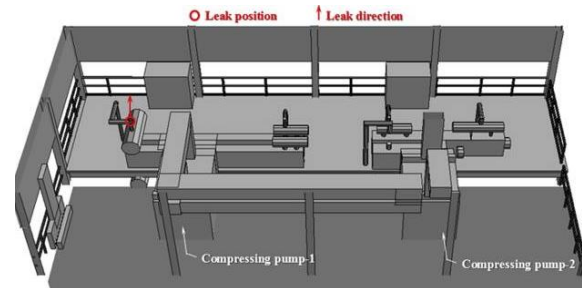


Figure 15 The 3D geometry of fire incident location

The scenario of a fire was studied on K.F.X. with input data (Table 1).

Table 1. Input data

Items	Input data	Incident outcome	Input data
Fuel	hydrogen, methane	Weather (speed of wind)	0.2 [m/s]
Fluids leak area	345.10 ⁻⁶ [m ²]	Surrounding temperature	20 [°C]
The rate of discharge	1.62 [kg/s]	Duration	30 [s]
Direction of leak	+Oz	Grid nodes	494.325 [ea.]

The damage caused fire was a flame.

4. RESULTS

The damage criteria are presented in the Table 2:

Table 2. The damage criteria

Temperature range [°C]	Temperature effects	Observations/Conclusions
426...730	<ul style="list-style-type: none"> grain structure, properties of steels corrosion resistance of steels corrosion resistance of stainless steels. the oxidation of steel with the temperature. 	<ul style="list-style-type: none"> Observing vessel, pipes. The components of tanks Testing and verifying the components of associated structural steel supports. Replacing the affected gaskets and packing. Cleaning, inspecting, testing the components of major equipment.
>730	<ul style="list-style-type: none"> Testing of heavy scaled steel on thermal stresses Testing of steel on ductility Testing the properties of all heat-treated or cold-worked materials. 	<ul style="list-style-type: none"> Testing the pipes and vessels on low temperature Testing the bolting, vessels and pipes components on metallurgical changes.

The thermal effects of this incident are presented in Table 3:

Table 3. The thermal effects of incident

Temperature [°C]	Material of construction	Usages	Thermal effects
595	Steel	Vessel, pipes	Thermal distortions and creep
1400	316 SS-cast*	Pumps, valves	Melts
1455	316 SS-wrought	Vessel, pipes	Melts
1515	Steel	Various	Melts

*"API-579 Fitness-For-Service," 2007.

The consequences of incident are presented in Table 4:

Table 4. The consequences of incident

Heat flux [kW/m ²]	The effects
37.50	Damage to operate with equipment, collapse of mechanical structures
25.00	Thin insulated steel can loss mechanical integrity
12.50	Wood ignition if it is a long exposure, 100% lethality
11.70	Thin partial insulated steel can loss mechanical integrity
10.00	The polymers can ignite

The results of this scenario are:

- radiant heat distribution of a jet fire (Figure 16);
- the heat flux (Figure 17);
- the temperature distribution on different stages of fire (Figure 18);
- the flame propagation (Figure 19).

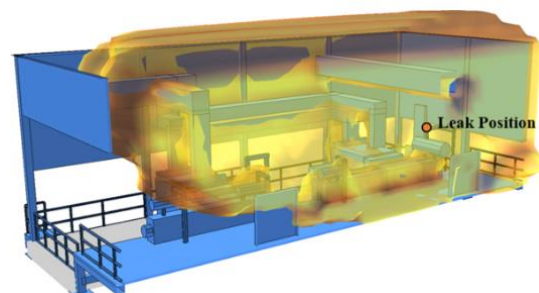


Figure 16 The radiant heat distribution of a jet fire

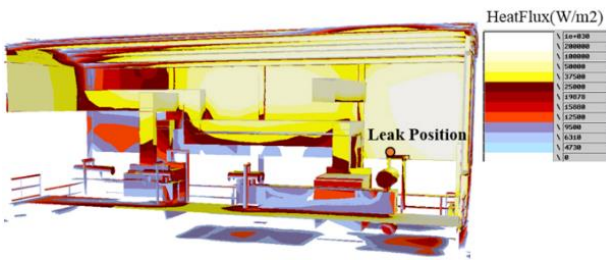
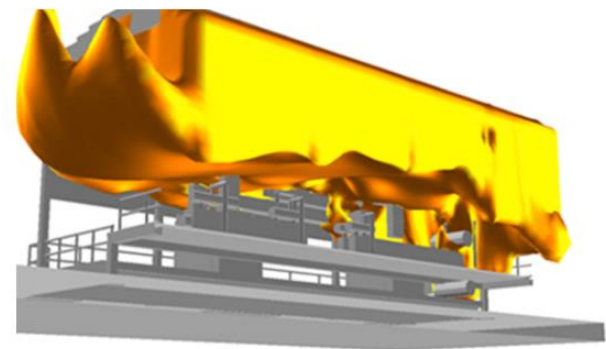
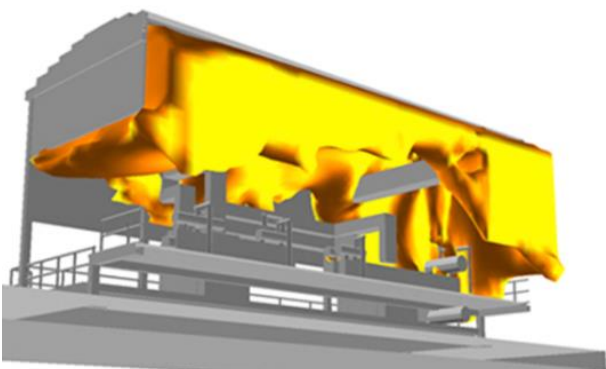


Figure 17 The heat flux



a) on 426⁰ C;



b) on 730⁰ C;



c) on 1400⁰ C;



d) on 1515⁰ C.

Figure 18 The temperature distribution on different stages of fire

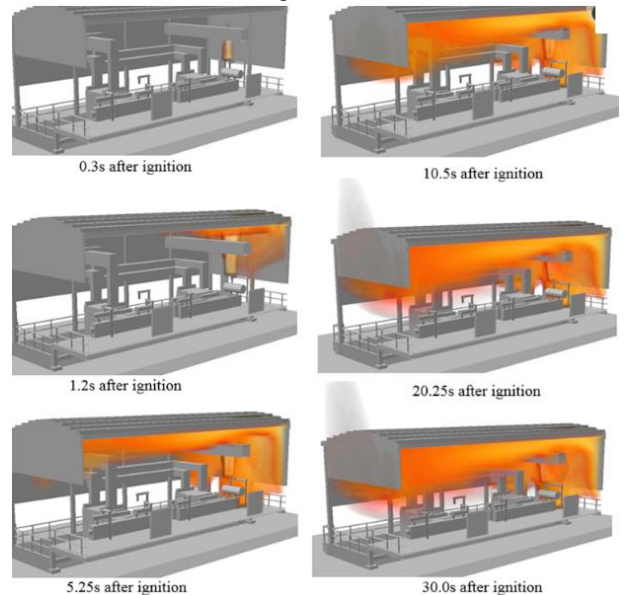


Figure 19 The flame propagations

The methods which used for simulation present a possible fire incident in a plant with many hazardous materials.

This method of simulation is useful to assistance plant owners and operators in different events of emergency situations. This methodology is useful to prevent human casualties and important structures.

With tools of this method, the study can be a real guide which help with solution and design safety measures (e.g. emergency and safety plans in case of fires)[8], [9].

5. CONCLUSIONS

The exploration of accidents in light of human error linked to underlying factors related to the human and organization work has been established as a major priority.



A fire incident caused by the leakage of mixed gas composed mainly of hydrogen was simulated using the KFX Code, a CFD simulator of RANS methodology, to compute the impact of flame, temperature, and radiant heat. Furthermore, the predicted damage on the shelter was analysed and proposed through the computation result.

It was confirmed that the KFX code was able to use the simulation method more effectively than the conventional empirical equation model to predict and analyse the damage result of a jet fire accident from a potential hazard.

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NUMERICAL SIMULATION OF CENTRIFUGAL PUMP

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Abstract : Centrifugal pumps are most commonly used pumping devices in industry their being fit for pumping water. There are several types of centrifugal pumps, their differences in construction is due to their size and how cloggy the pumped water is.

In the paper it was simulated a 2D centrifugal pump of small size used in daily activities. The simulation, performed with CFD (ANSYS-Fluent), was made for different inlet velocities of water. Different parameters, such as inlet pressure, outlet pressure, maximum velocity and flow rate, were calculated and graphically represented against inlet velocity. Also, graphical representation of pressure distribution and velocity distribution inside the impeller were presented for a better comprehension of the physical phenomena.

Key words : centrifugal pump, numerical simulation, finite element analysis.

1. INTRODUCTION

Hydraulic turbo-generators (turbo-pumps), creates an energy transfer at the impact between the rotor blades and the fluid flow, increasing the kinetic moment of the fluid. [2]

The fluid passes through the suction zone, enters the rotor, where a kinetic energy is imprinted on it, transforms it into potential energy in the spiral chamber and exist through the discharge zone. [1]

We will consider a 2D section of a centrifugal pump. It functionality, working principle and energy conversion its better visualized in two dimensions.

In Figure 1 is shown a representation of a centrifugal pump, Bernoulli's equation.

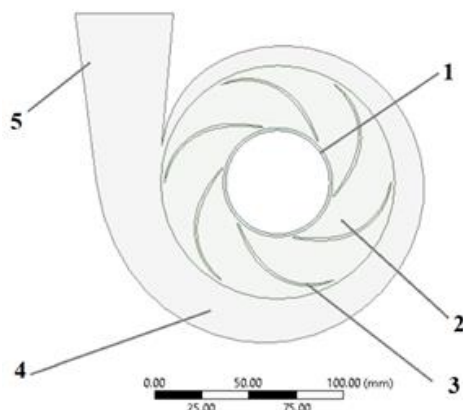


Figure 1 Representation of a centrifugal pump

where:

1 – inlet zone (ring);

2 – impeller;

3 – blade;

4 – spiral chamber;

5 – diffuser.

The spiral chamber has the property to convert kinetic energy into potential energy. The continuity equation (1) tells us that the flow rate is constant no matter the section. Of course, this equation has certain limitations and applicability. [1]

$$Q = v_1 \cdot S = const. \quad (1)$$

In the same time, Bernoulli's equation (2), under pressure form, shows that and decrease of dynamic pressure will result an increase of static pressure, or vice versa. [1]

$$\frac{\rho v^2}{2} + p_s = const. \quad (2)$$

Since velocity is decreasing due to the increase of section, it means the dynamic pressure will decrease hence the static pressure will increase. The latter is necessary the overcome the loss of pressure due to friction.

The larger the section of the spiral chamber on the outlet part, the smaller the velocity, the bigger the static pressure will be. Hence, designing the centrifugal pump depends on its industrial purposes.

2. CENTRIFUGAL PUMP SIMULATION

2.1 Centrifugal pump characteristics:

Centrifugal pumps have a wide range of applications and they can vary in size from a few of centimetres in

diameter for domestic applications up to half a meter in diameter or more for industrial applications.

Main characteristics of the centrifugal pump:

- inlet diameter (ring) - 55.0 mm;
- interior diameter of the impeller - 58.0 mm;
- exterior diameter of the impeller - 124 mm;
- number of blades - 6;
- angular velocity - 2900 rpm.

2.2 Pump discretization :

After the geometric representation of the centrifugal pump, the discretization is shown in Figure 2.

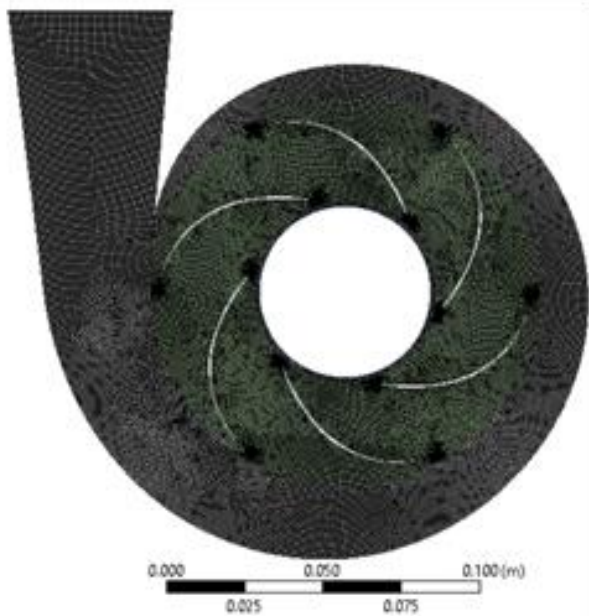


Figure 2 Centrifugal pump discretization

The centrifugal pump is discretised in approximately 27.500 polyhedral cells with 29.000 knots.

2.3 Boundary conditions :

Flow rate can be deduced using equation (3). Length of the circle was used instead of surface, due to 2D simulation.

$$Q = v_1 \cdot \pi D_i \left[\frac{l}{s} \right] \quad (3)$$

Following conditions were used in ANSYS – Fluent v.22:

- water was selected as fluid, with a density of $1000 \frac{kg}{m^3}$;

- inlet velocity of water was set to 0.5 m/s, 1 m/s, 1.5 m/s, 2 m/s;
- The fluid model used was k-omega is turbulent with a Prandtl number equal to 0.667.
- the water dynamic and cinematic viscosity are constant and are equal to $10^{-3} \frac{kg}{ms}$, $10^{-6} \frac{m^2}{s}$, respectively;
- The turbulence viscosity ratio is set to 10.

There were performed 4 different simulation regarding the inlet velocity imposed at 0.5 m/s, 1 m/s, 1.5 m/s and 2 m/s and observed how the suctions pressure, outlet flow and maxim velocity and pressure changes at constant angular velocity of 2900 rpm.

2.4 Results and discussions:

All the simulations were performed using the boundary conditions presented above.

The solutions converged after all the residuals reached the value of 10^{-4} .

Four scenarios were performed where only the inlet velocity was changed. For instance, pressure distribution, velocity distribution and vectors distribution are presented below for an inlet velocity of 1.5 m/s.

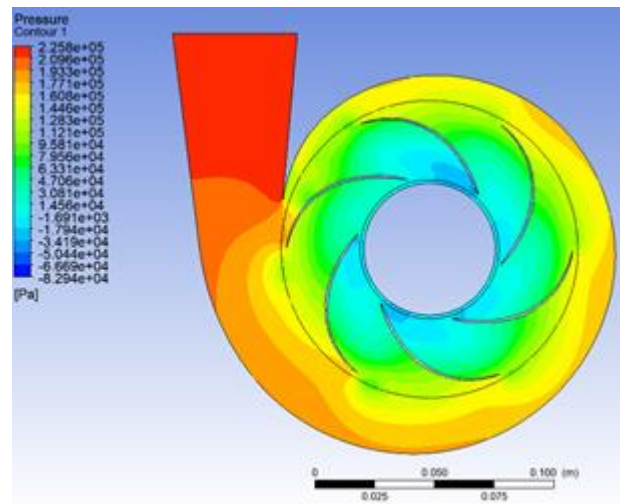


Figure 4 Pressure distribution

In parallel to Figure 4, velocity distribution from Figure 5 and vectors distribution in Figure 6 shows an agreement in Bernoulli's equations (where pressure is higher, velocity is lower). Also, it can be observed that maximum velocity reaches a value close to 26 m/s.

Velocity vectors distribution shows the way the particles leaves the ring zone, enter the impeller where their velocity magnitudes increases up to 26 m/s and the magnitude drops linear due to the increase of section of the spiral chamber.

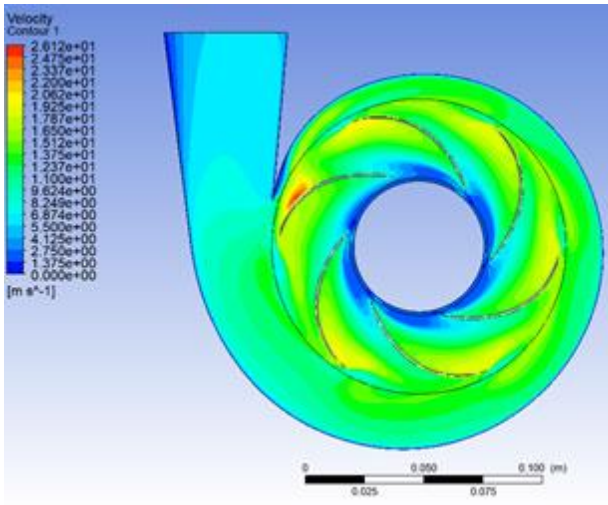


Figure 5 Velocity distribution

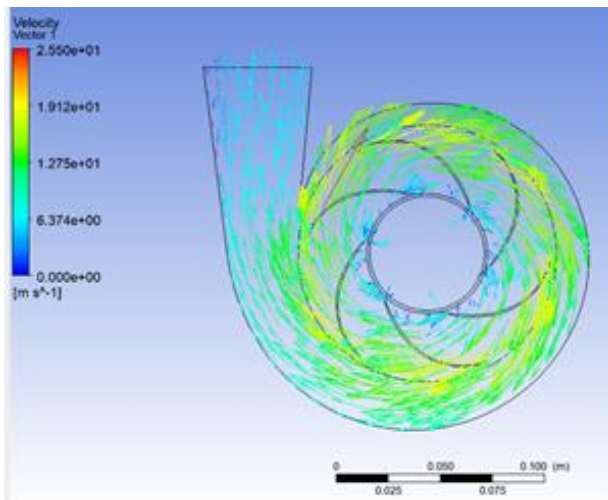


Figure 6 Velocity vectors distribution

For others scenarios was chosen an inlet velocity of 0.5 m/s, 1 m/s and 2 m/s respectively. Than were compared different parameters for all four simulation: inlet pressure, outlet pressure, maximum velocity, flow rate.

2.5 Discussions about results

In Table 1 it is presented the values of the main parameters with respect to inlet velocity.

Table 1. The results of simulation

Inlet velocity [m/s]	0.5	1	1.5	2
Inlet pressure [Pa]	6400	3200	-6000	-11500
Flow rate [l/s]	0.08	0.17	0.26	0.345

Maximum velocity [m/s]	27	26.8	26	20
Outlet pressure [bar]	2.25	2.14	2.10	1.8

Then graphs were created accordingly for a better comprehension of the phenomena implied.

3. CONCLUSIONS

Finite Element Analysis is a method to solve the mathematical model and to simulate the complex phenomena of Fluid Mechanics.

Therefore the person who uses a simulation program of a real physical phenomenon by finite element method using computer must well understand the physical processes that take place and to be able to correctly interpret the data that the computer has to offer.

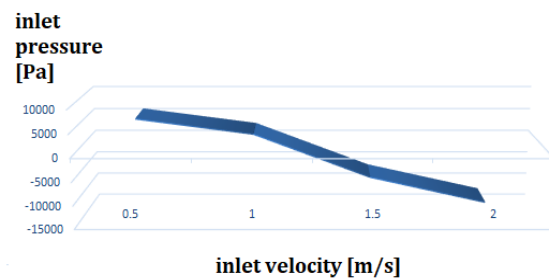


Figure 7 Inlet pressure vs. inlet velocity

According to equation 3 flow rate is directly proportional with velocity, thus higher inlet velocity implies a higher flow rate (Figure 8).

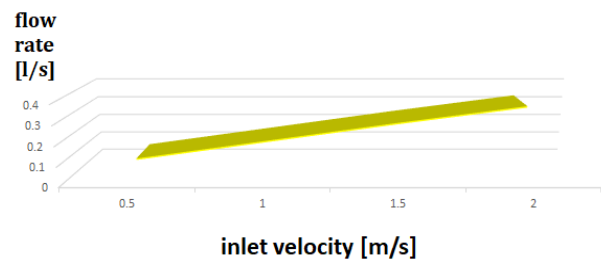


Figure 8 Flow rate vs. inlet velocity

Maximum velocity is reached at the end of the rotating blades. From there, in spiral chamber kinetic energy is converted into pressure energy, thus static pressure will increase (Figure 4). In Figure 9 It is observed a slowly decrease of maximum velocity with respect to inlet velocity up to 1.5 m/s, than a drastically decrease of the maximum velocity. This is due to the fact that inlet velocity enters radially while maximum velocity exists tangentially. Thus, inside the impeller we

have a loss of pressure due to friction and due to the fact more energy is consumed to change the direction of the flow.

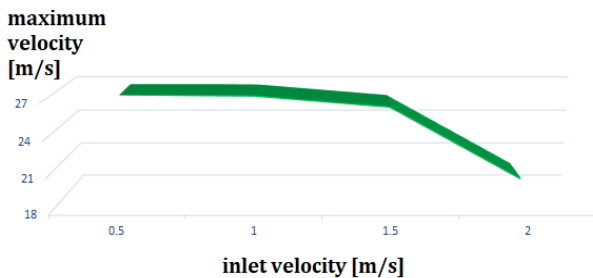


Figure 9 Maximum velocity vs. inlet velocity

Similar, in Figure 10 it is observed a slow variation of the outlet pressure up to velocity 1.5 m/s, than a more acute decrease of the pressure. Here, maximum velocity and outlet pressure are proportional due to the fact that loss of kinetic energy implies a loss in potential energy.

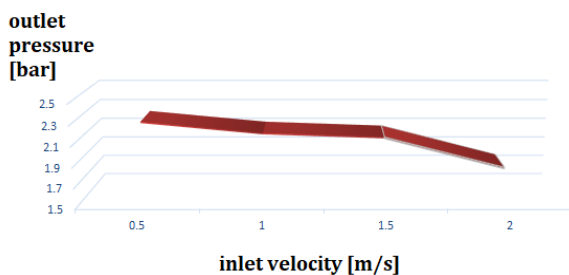


Figure 10 Outlet pressure vs. inlet velocity

More simulations were performed for higher inlet velocities, but it was noticed that the inlet pressure reaches values below (-1) bar, which implies it is not physically possible. So inlet velocity has a maximum value (depending on the dimensions of the pump, revolution per minute) that can be imposed.

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PERFORMANCE ANALYSIS OF INERT GAS PLANT WITH SCRUBBER USING ANSYS FOR A VLCC SHIP

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Abstract: Through the 1978 SOLAS Protocol and then through the introduction of amendments from 1981 and 1983, new specifications are brought regarding the design, operation, maintenance, verification of inert gas systems intended for both oil tanks and bulk chemical tanks, and, in general, the systems of safety on board ships carrying dangerous goods. The inerting method using a gas system with generator and scrubber involves a continuous and very efficient process, with a low level of supervision and maintenance, that is why this type of installation was chosen in this study. Installations with a scrubber type unit require the installation of an inert gas generator that operates at a pressure of 8-10 bar and releases nitrogen at 7-9 bar. The quality of the air will depend on the type of generator used, scrubber type unit, but air without impurities with the best possible quality is recommended. Nitrogen quality for a given unit varies with production rate and is generally 95-97% pure. By connecting high-quality scrubbers, nitrogen can be brought to 99% purity, but at lower production rates and much higher energy consumption rates of any system on board ship is specifically identified with its reliability. So as to get the best out of marine motors, it is critical to screen their performances and take measures to accomplish productive combustion. As a result of heat gains on board ships from engine rooms and crew, the increase in humidity as well as due to the various releases of gases from on board systems, room air deteriorates, requiring replacement and its processing through the HVAC (heat, ventilation and air conditioning) system. The combustion process in diesel engines is the most complex and difficult to address. HVAC system has a definitely role for diesel engine combustion.

Key words: VLCC, engine room, inert gas, scrubber, simulation analysis system.

1. INTRODUCTION

New oil tankers provided with fixed washing and tank cleaning installations must be mandatorily equipped with an inert gas installation that meets all the international requirements imposed by Rule 62, SOLAS Safety - Life Safety on the Sea). All oil stations with a fixed inert gas installation must be equipped with a closed oil measurement system ("UTI - temperature indicator oil").

Currently, the inert gas installation must be constructed and tested to maintain a non-flammable atmosphere in all the ship's tanks, except when these tanks must be degassed. The inert gas installation must meet the following conditions:

- to ensure the inertness of empty cargo tanks by reducing the concentration of O₂ in the tanks to a level at which combustion cannot be maintained;

- to maintain the atmosphere in any area of a cargo tank at a concentration below 8% for the entire duration of the voyage and/or for the entire duration of the operation of the petroleum products in the terminal berth;

- the installation should not require the introduction of air into the tank under normal working conditions except when the tank needs to be degassed;

- the inert gas installation must ensure an inert gas flow of 125% of the vessel's maximum discharge flow expressed in volume;

- the inert gas installation must ensure a permanent flow of inert gas with an inert gas concentration that does not exceed 5% at the mains level;

- on the inert gas main, the valve will be provided to isolate the combustion gases between the boiler chimney (evacuation manifold) and the scrubber. This valve had to be provided with an indicator showing the position of the closing device. Measures shall be taken to keep this valve gas-tight and to keep their seats free of deposits. Measures will be taken to block the operation of soot blowers and boilers when this valve is opened;

- for the effective cooling of the gas particles and the elimination of the solid ones as well as (mandatory) the compounds resulting from the combustion of sulphur, a gas purifier (scrubber) is provided, the scrubber will be supplied with the necessary water without causing any inconvenience;

- a filter or equivalent device will be provided to reduce the water content of the gas flow before it enters the fan;

- the gas purifier (scrubber) will always be located behind the cargo tanks, the pump room and the cofferdam that separates this compartment from the engine compartment;

- the two ventilators must together ensure a gas volume of 125% of the maximum discharge volume of the vessel;

- the inert gas generator must be autonomous and be equipped with two fuel pumps. The Administration can also accept the request of a single pump, provided that there are enough spare parts for it on board;

- the inert gas installation must be designed and built in such a way that the maximum pressure that the inert gas ventilators can achieve does not exceed the value of the test pressure of any cargo tank. Appropriate closing devices will be provided for the suction and discharge pipes;

- for all cargo tanks, the gas evacuation piping must be located as far as possible from the inert gas entry point; thus, the suction of these pipes will be placed immediately under the deck at a distance of 1 m above the bottom of the tank;

- ensuring the possibility of adjusting and calibrating the value of the O₂ concentration and the maximum limit, on the scale of the device, thus, for the O₂ analysis it will be: O₂ 21%, for the explosimeter the scale will be calibrated in 00% L.O.FL1. The fixed devices in the installation, the O₂ analyser will be calibrated with the help of a pure gas that does not contain oxygen, this is nitrogen.

For the oxygen installation with an autonomous generator, the following alarms appear:

- alarm for insufficient fuel supply;
- alarm when the power source of the autonomous generator fails;
- alarm for the failure of the power supply of the autonomous control system;

All alarms will be placed both in the cargo room and in the car compartment. these instructions must include emergency procedures to be used in case of partial failure or non- functioning of the inert gas installation.

The inert atmosphere is defined as the atmosphere in which ignition, combustion cannot take place due to the low concentration of O₂. Such an atmosphere is composed of gases such as: N, Ar, Kr, He, CO₂, CO. To obtain the inert gas, the following methods are used:

- separation of hydrogen from ammonia (NH₃);
- liquids;
- gas resulting from combustion: exhaust gas the residual gases resulting from the combustion of diesel fuel are: N – 74.5%, CO₂ – 12.5%, H₂O – 12.5%, SO₂ – 0.04%.

The composition of combustion gases from marine boilers, inert gas generators under normal working conditions and good technical condition of the

combustion and combustion control equipment (otherwise the values are altered) are: O₂ – 43%, CO₂ – 5% , N – 77 % , H₂O – 5 % , SO₂ – (0.3 - 0.5) % , CO – (1000 - 10000) ppm, NO – 4000 ppm, solid suspensions 150-200 mg/m³. At the same time, good combustion is defined as the best atomization of the fuel towards the combustion chamber (injection). The principle diagram of an inert gas installation on board a ship is shown below, in figure 1:

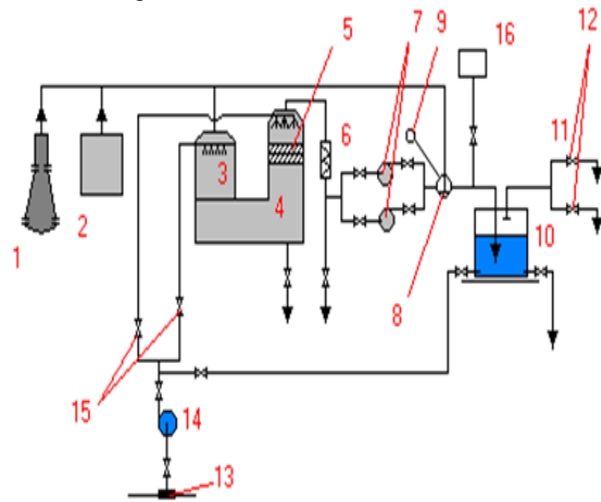


Figure 1 Basic diagram of the inert gas installation

Above is the basic diagram of a complete inert gas installation. The component elements of the installation in the figure above are: 1 – main engine, with internal combustion; 2 – boiler; 3 – cooler; 4 – scrubber; 5 – filter material; 6 – droplet separator; 7 – fans; 8 – three-way valve; 9 – O₂ analyser; 10 – hydraulic shutter (deck seal); 11 – GI highway; 12 – inert gas distribution valve; 13 – Kingstone outlet; 14 – sea water pump; 15 – seawater diverter valve; 16 – autonomous inert gas generator.

The papers sent to the journal secretariat for publishing will be edited in DOC format. Editing board will convert the Word files in PDF format.

2. ENGINE ROOM FOR VLCC SHIP

To obtain good working conditions in the engine room, it is necessary to investigate its layout from a very beginning of any design. Attention shall be paid to the ventilation, transport ways, escapes, maintenance hatch and space for maintenance etc. The accommodation block is usually arranged above the engine room and both of them must be very well coordinated to create one logical solution.

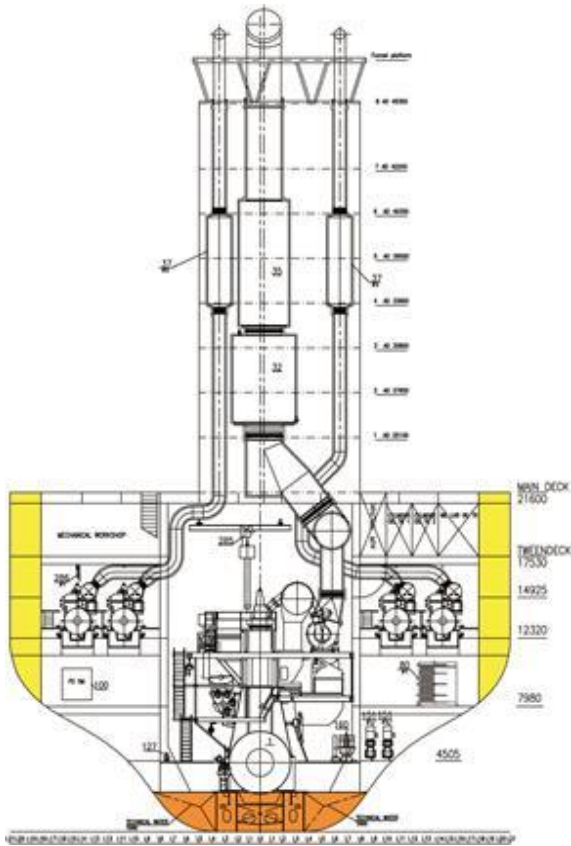


Figure 2 Engine room arrangement

Table 1. Main engine characteristics

Characteristics	Value
Bore	850 mm
Stroke	3150 mm
Number of cylinders	7
MCR power	27020 kW
NCR power	22965 kW
Speed	76 rpm

3. MITSUBISHI-UE MDE 7UEC85LSII MAIN ENGINE

MITSUBISHI-UE MDE 7UEC85LSII is a two-stroke, slow speed and reversible engine, with a constant overcharging pressure that develops a rated output of 27020 kW at a speed of 76 rpm, the ship shifting with a maximum speed of 16 kN (knots). MITSUBISHI type 7UEC85LSII two-stroke engine has big bore size and a total power output up to 20000 kW, being part of the category of high efficiency slow engines.



(a)

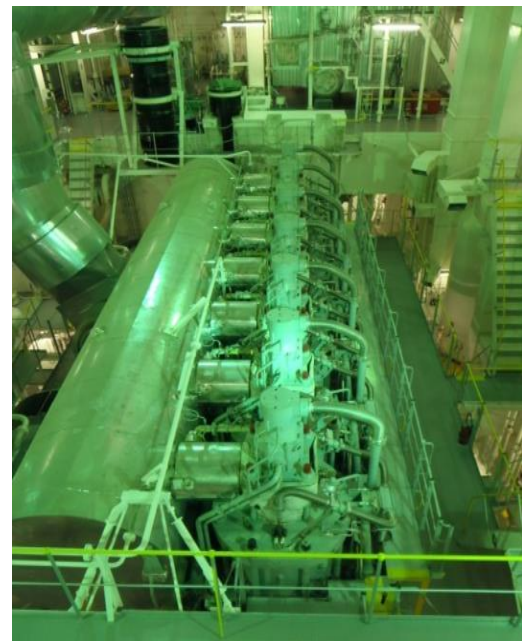


Figure 3 MITSUBISHI 7UEC85LSII main engine: (a) side picture; (b) top picture [real photo onboard VLCC ship of 305000 tdw

• Energy balance for main engine

For main diesel engine we have formulas for heat flux:

$$\dot{Q}_{rad} = (0.02 \dots 0.04) \cdot \dot{Q}_d [kW], \quad (1)$$

$$\dot{Q}_d = \frac{1}{\eta_e} \cdot P_e = \frac{22965}{0.45} = 51033 [kW] \quad , \quad (2)$$

$$\dot{Q}_{rad} = 0.02 \cdot 51044 = 1020 [kW] \quad , \quad (3)$$

where

- \dot{Q}_{rad} – radiant heat flux;

- \dot{Q}_d – dissipated heat flux;
- P_e – engine effective power;
- η_e – effective efficiency.

Mass air flow calculation for engine room:

$$\dot{Q}_{rad} = \dot{m}_{air} \cdot c_{air} \cdot \Delta t [kW] , \quad (4)$$

$$\dot{m}_{air} = \frac{\dot{Q}_{rad}}{c_{air} \cdot \Delta t} \left[\frac{Kgair}{s} \right] , \quad (5)$$

where

- $\dot{m}_{air} \left[\frac{Kgair}{s} \right]$ – air mass flow;
- $c_{air} = 1 \left[\frac{KJ}{KgK} \right]$ – specific air heat;
- $\Delta t = [5 \dots 10] [K]$ – temperature difference;

$$\dot{m}_{air} = \frac{1020}{1 \cdot 10} \left[\frac{Kgair}{s} \right] , \quad (6)$$

$$\dot{m}_{air} = 102 \left[\frac{Kgair}{s} \right]. \quad (7)$$

Volume air flow calculation for engine room:

$$\rho = \frac{P}{RT} \quad (8)$$

$$\rho = \frac{100}{0.286 \cdot 300} \quad (9)$$

$$\rho = 1.16 \left[\frac{Kgair}{m^3} \right] \quad (10)$$

where

- $P \left[\frac{KN}{m^2} \right]$ – air pressure;
- $R = 0.286 \left[\frac{KJ}{KgK} \right]$ – gas constant;
- $T = 300 [K]$ – air temperature;
- $\rho = 1.16 \left[\frac{Kgair}{m^3} \right]$ – air density.

$$\dot{V} = \frac{\dot{m}_{air}}{\rho} , \quad (11)$$

$$\dot{V} = \frac{102}{1.16} , \quad (12)$$

$$\dot{V} = 87.9 \left[\frac{m^3}{s} \right] . \quad (13)$$

Volume air flow calculation for engine room fan:

$$P_{fan} = \frac{\dot{V} \cdot \Delta P}{\eta_{fan}} [kW] \quad (14)$$

$$\Delta P = \frac{80 \cdot 100}{10200} = 0.78 \left[\frac{kN}{m^2} \right] , \quad (15)$$

$$\dot{V} = \frac{0.75 \cdot 92}{0.78} = 88 \left[\frac{m^3}{s} \right], \quad (16)$$

where

- $P_{fan} = 92 [kW]$ – fan effective power;
- \dot{V} – volumic air flow;
- $\eta_{fan} = [0.65 \dots 0.75]$ – fan efficiency;
- ΔP – pressure difference.

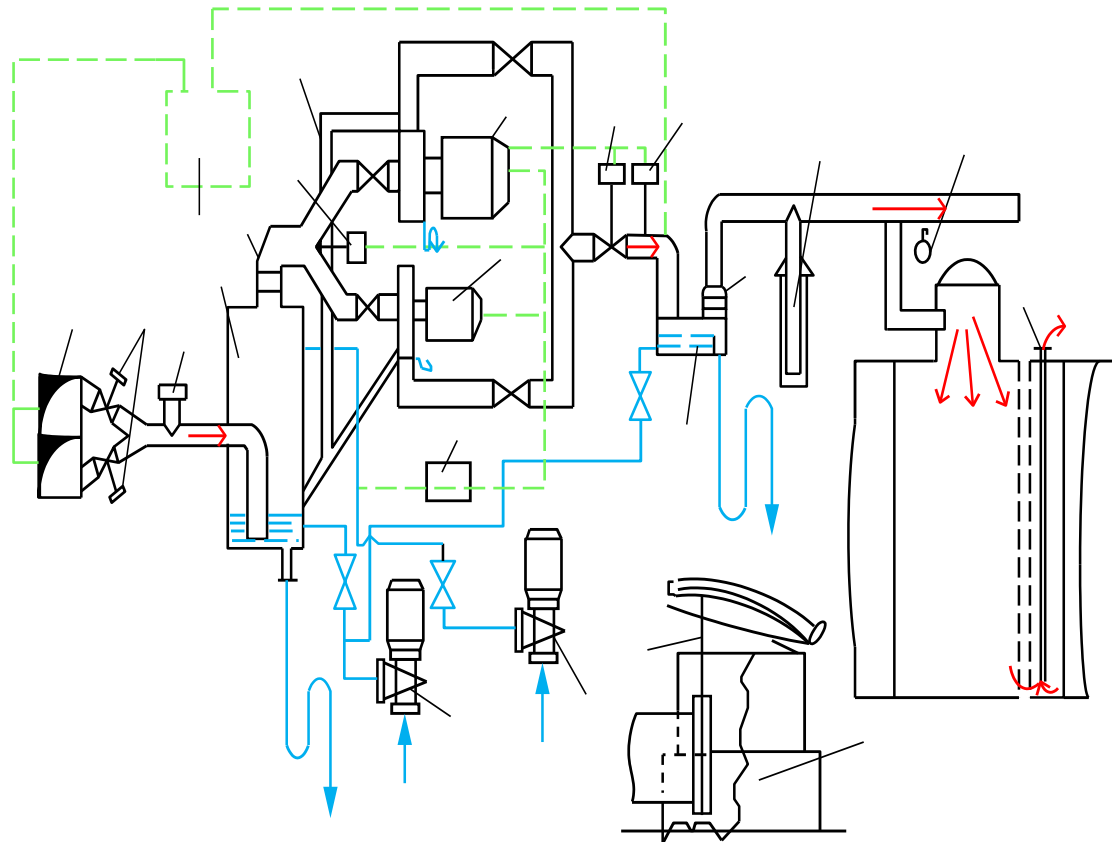


Figure 4 Basic diagram of an inert gas installation with a scrubber

Therefore, due to its advantages, for a 50,000 tdw oil tanker, an inert gas installation with a scrubber is chosen. The operation of the inert gas installation that was chosen is presented in more detail above. This installation is the simplest, from a constructive point of view, of all the types of inert gas installations that can be installed on board ships and presents a series of advantages that can justify the choice of this variant.

The main component of the inert gas installation on board the oil tanker is the gas generator produced by the Finnish company Wärtsilä, at the Guangzhou Shipyard International. The type of generator is Wärtsilä Moss, with the following general characteristics:

- Capacity: 4125 Nm³/h;
- In production in 2015;
- Order: 1310045;
- Pressure: 0.12 bar at 100% capacity;
- Normal oxygen content: 1 – 5% (the level is adjustable in the mentioned interval);
- Gas composition at O₂ = 3% by volume;
- Gas temperature at the cooling tower: maximum 5 °C higher than the water temperature at the suction flange;
- Fuel consumption: 304 kg/h;
- Sea water consumption: 236 m³/h with a 3 mm

filter;

- Pressure (at the cooling tower): approximately 2 bar;
- Temperature rise: 13 °C;
- Flow through the seawater seal: 3 m³/h;
- Sealing pressure: 1 bar;
- Electric motor power at 100% capacity of the auxiliary blower: 86 kW;
- Power of the electric motor of the fuel supply pump: 1.8 kW;
- Instrument air: 4 Nm³/h.

4. PERFORMANCE ANALYSIS OF SCRUBBER INERT GAS PLANT USING ANSYS

As it was mentioned before, due to its advantages, for the 50,000 tdw oil tanker, an inert gas installation with a scrubber is preferred. This installation is the simplest, from a constructive point of view, of all the types of inert gas installations that can be installed on board ships and presents a series of advantages that can justify the choice of this variant. The operation of the inert gas installation that was chosen is presented in more detail below, using the specialized Ansys software:

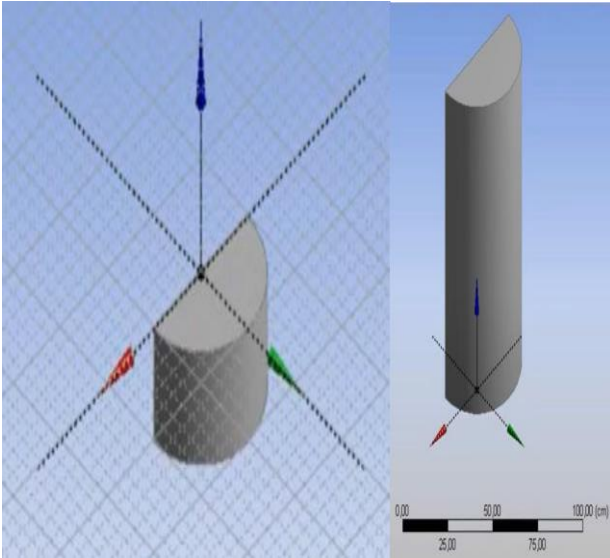


Figure 5 Network of nodes

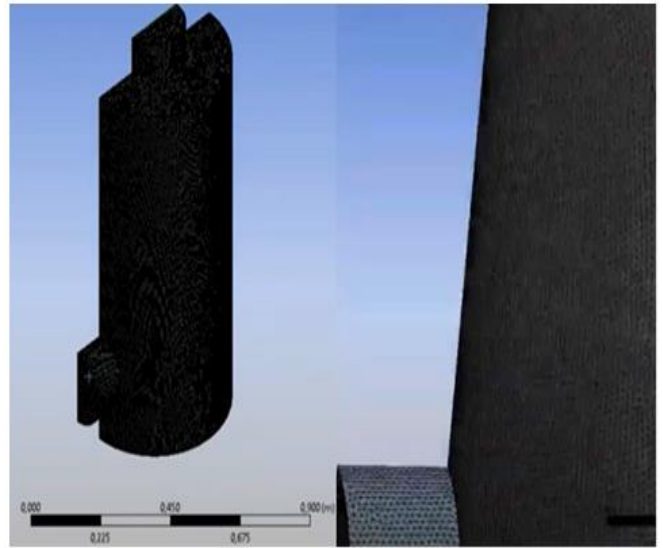


Figure 7. Discretization of the scrubber model

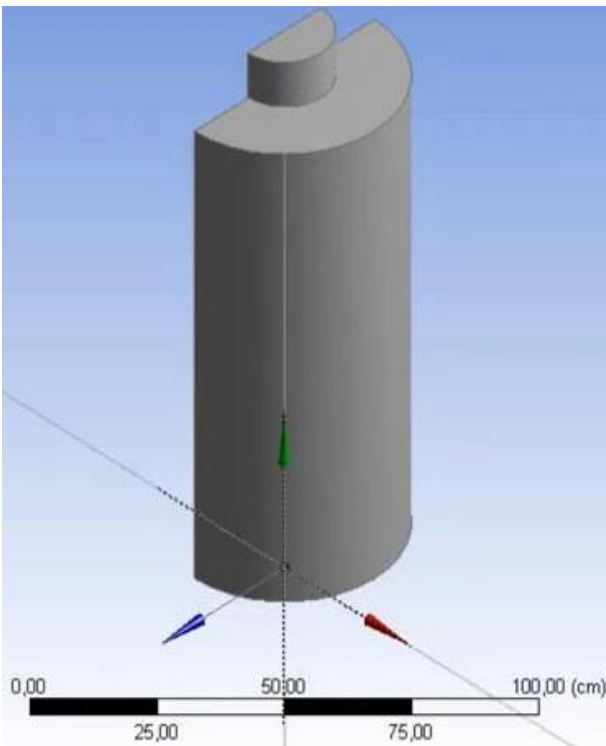


Figure 6 Creating the scrubber model of the inert gas plant

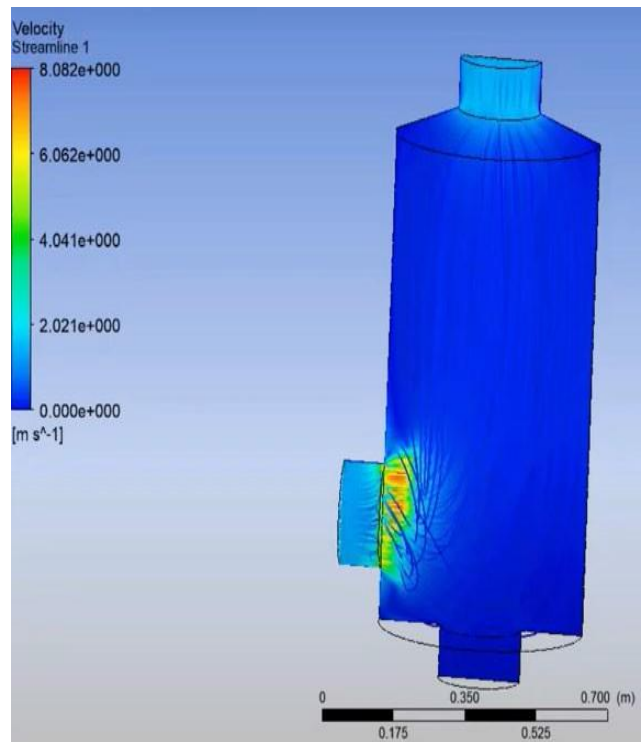


Figure 8. Simulation of velocity fields of velocity streamlines

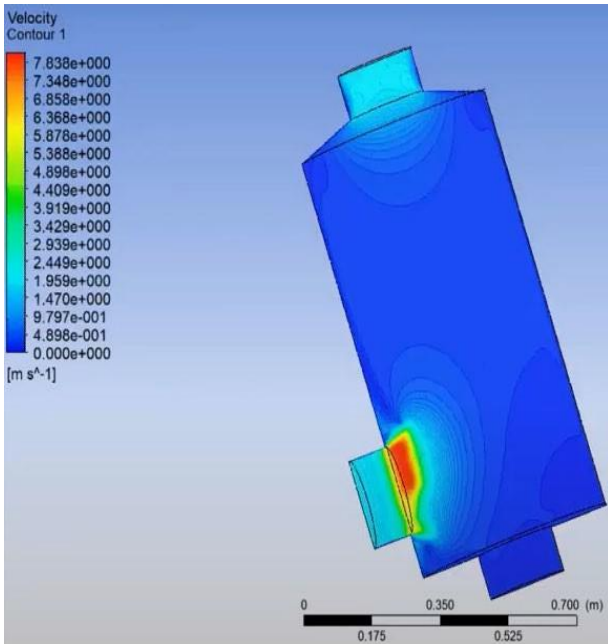


Figure 9. Simulation of velocity contours

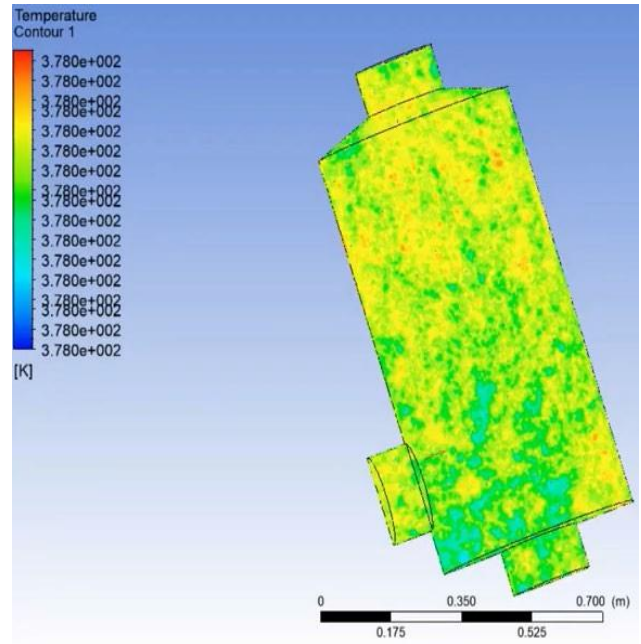


Figure 11 Temperature variation during operation

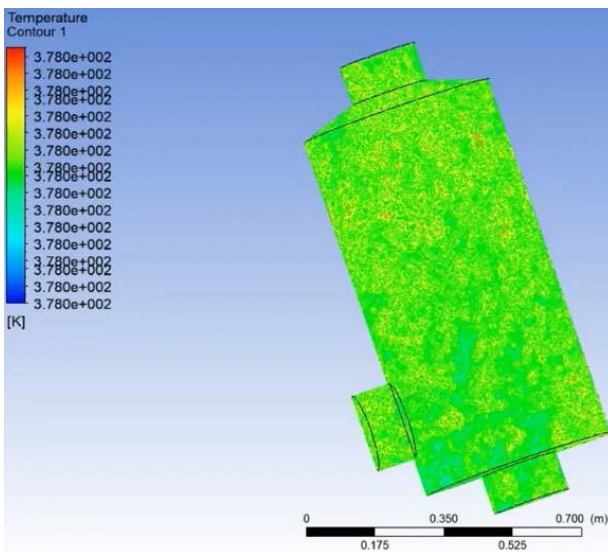


Figure 10 Analysis of pressure variation

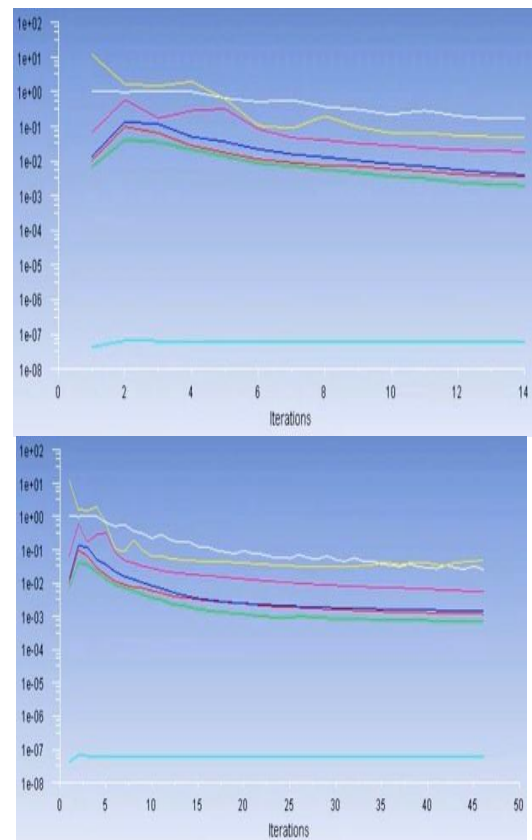


Figure 12 Parameter variation during iterations



5. CONCLUSIONS

Two things play a major role in how profitable an oil tanker can be, one is flexibility, the other is keeping costs to a minimum. Both depend on certain equipment, such as the inert gas system installed on board the ship. An oil tanker's inert gas system is vital to safety and efficiency during cargo operations.

In a typical oil tanker the inert gas system operates around 750 hours per year. To avoid delays and costly penalties, it must perform whenever needed, despite continuous exposure to high temperatures and seawater. This is the reason why durable materials and the best quality components are used for the construction of these equipments, to which are also added effective maintenance solutions.

Fuel efficiency is important to both the economy of the tanker and the environment. Modern systems such as Smit Combustion prevent the loss of inert gas by exhausting the water so that the fuel used is not wasted. This is a unique feature for inert gas generators. The Smit Combustion System is a low-pressure, fuel-burning system for inert gas production. Using the Ultramizing system, it produces soot-free inert gas with an oxygen content of 2 - 4%, even when operating under stoichiometric conditions. To save fuel, it can also be equipped with an automatic fuel efficiency module.

Fuel Efficiency Mode (or AFEM), which constantly adjusts inert gas output to current needs. By using a system of this type, just the right amount of inert gas is produced, with the AFEM adjusting the amount of fuel to compensate for environmental factors and keep the oxygen percentage stable. The quality of the inert gas is also important, and that means that it is generated and used without soot.

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AN ATTEMPT TO IMPROVE ENERGY EFFICIENCY OF VAPOUR COMPRESSION REFRIGERATION ON SYSTEMS WORKING WITH R134a

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Abstract: Refrigeration is an industry of high importance in our modern times. It plays also a key role in maritime transport of perishables, where vapour compression refrigeration systems are dominant. These energy systems are indispensable, but they should be wise exploited because their high energy necessity. One of the frequent refrigerant chemical adopted in this system is the hydrofluorocarbon R134a. This refrigerant came to substitute traditional refrigerants, such as chlorofluorocarbons or hydro chlorofluorocarbons – substances being under environmental regulations. In this study, it is approached a single stage vapour compression refrigeration system working with R134a. The aim is to find the conditions in which this system is more energy efficient. In this respect, based on the laws of thermodynamics, are obtained information on Coefficient of Performance and energy destruction trends – when the evaporator temperature increases. Our results indicate that, although the analysis based on the first law of thermodynamics reveals that the performance of the system is higher for high evaporator temperatures, the energy destructions in this system increase together with the evaporator temperature increase.

Key words: vapour compression refrigeration, performance, exergy, evaporator temperature.

1. INTRODUCTION

Vapour compression refrigeration systems (VCRSs) are energy systems playing a key role in cooling and preservation, while consuming high amounts on energy; in this respect, energy efficiency when using these systems in of high importance [1].

On board the ships, VCRSs are able to keep a constant temperature while transporting chilled or frozen goods [2].

Energy efficiency aspect is not the only research direction; the environmental aspect of the use of these systems is also a topic to be considered. Despite the advantages shown by the refrigerants belonging to chlorofluorocarbons (CFCs), such as good thermo physical behaviour and chemical stability, these working fluids were banned because of the chlorine release; after signing the Montreal Protocol (1987), ozone depleting substances are under regulations and Hydrofluorocarbons (HFCs) are now in use [3].

Marine refrigeration, as any other refrigeration sector, deals with ozone layer protection and global warming; this means that refrigerants on board the ships have not to be harmful for the ozone layer (ODP=0) and to have a low contribution to the global warming (low value of its GWP) [4].

Since the role of VCRSs is to remove heat from a zone with a lower temperature to another one, with a higher temperature, these systems needs four main elements: compressor, condenser, expansion valve and evaporator, the closed cycle being shown in Figure 1. Here can be observed the following processes: isentropic compression of vapours, cooling and condensation of saturated vapours – with heat rejection, isenthalpic expansion of saturated liquid, evaporation of vapour-liquid mixture – with heat absorption [5], [6].

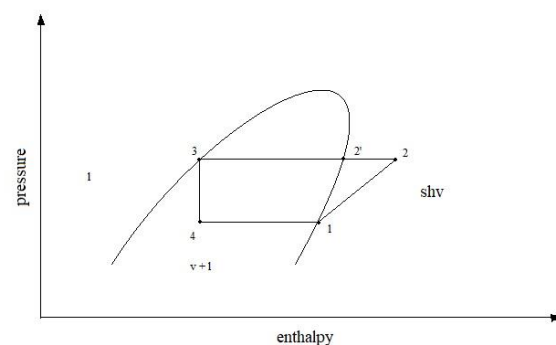


Figure 1 VCRS cycle without super heating and sub cooling [5]

The processes taking place in each main part of the plant are given below:

- 1-2 – in the hermetic compressor – reciprocating type,
- 2-2'-3 – in the condenser,
- 3-4 – in the expansion valve,
- 4-1 – in the evaporator.

The evaporator and the condenser are two heat exchangers, in which the refrigerant changes its phase with heat absorption (evaporator) and heat remove (condenser).

The compressor is able to increase both pressure and temperature – with work consumption.

The expansion valve is able to decrease pressure, being also seen as a control valve of the refrigerant flow.

The refrigerant selected for this study is R134a, a HFC often used in VCRSs met on board the ships. R134a is in A1 safety group and it is also known as 1,1,1,2 – tetrafluoroethane.

Some of its properties are provided below [7]:

ODP=0

GWP₁₀₀=1430

molecular mass = 102 g/mol

critical temperature = 374, 2 K

critical pressure = 4, 06 MPa.

R134a is not toxic or flammable and also it is not corrosive.

It has a high heat of vaporization and a medium density value in liquid form.

This paper deals with a theoretical analysis of a VCRS with no superheating and no sub cooling.

The thermodynamic analysis is based on both first and second laws of thermodynamics, in order to get a realistic image when energy efficiency is aimed.

2. METHODS AND MATERIALS

Any theoretical assessment of VCRSs is based upon the following assumptions: [8]

- the operation is according to steady state regime;
- R134a in saturated vapour state enters in the compressor;
- pressure losses are neglected in pipes and valves;
- heat gains and heat losses are also neglected;
- theoretical isentropic efficiency of the compressor is 75%.

The classical thermodynamic analysis was initially developed only on the first law of thermodynamics. According to this law, which is the law of energy conservation, it is not possible to be aware about the energy degradation in a refrigeration system.

In order to have information on energy losses, it is compulsory to apply exergy analysis [9].

When applying the first law of thermodynamics, it is possible to find only one indicator

of performance: the Coefficient of Performance (COP). By applying the exergy analysis, one can find the energy losses in the components of the system and the total energy loss. Exergy is a concept introduced by the second law of thermodynamics; it gives the measure of the useful energy.

The necessity of this approach derives from the fact that all the real processes are irreversible. The irreversibilities encountered in refrigeration cycles have the following causes [10]:

- friction;
- heat transfer through finite temperature difference;
- super heating and sub cooling;
- pressure drops;
- heat gains.

The aimed results will be obtained by applying the following mathematical modelling [11]:

Heat absorbed in the evaporator:

$$Q_e = m_r(h_1 - h_4) \quad , \quad (1)$$

where:

m_r – mass of refrigerant, kg.;

h – enthalpy, kJ/kg;

Heat evacuated at the condenser:

$$Q_c = m_r(h_2 - h_3) \quad . \quad (2)$$

Work consumption at the compressor:

$$W_{cp} = m_r(h_2 - h_1) \quad . \quad (3)$$

Exergy loss in the evaporator:

$$I_{lv} = m_r[(h_4 - h_1) - T_0(s_4 - s_1)] + Q_e \left(1 - \frac{T_0}{T_e}\right) \quad , \quad (4)$$

where:

s – entropy, ky/(kgK);

T_0 – ambient temperature, K;

T_e – evaporator temperature, K;

Exergy loss in the condenser:

$$I_{lc} = m_r[(h_2 - h_3) - T_0(s_2 - s_3)] - Q_c \left(1 - \frac{T_0}{T_c}\right) \quad , \quad (5)$$

where:

T_c – condenser temperature;

Exergy loss in the compressor:

$$I_{lcp} = m_r[(h_1 - h_2) - T_0(s_1 - s_2)] + W_{el} \quad (6)$$

where:

W_{el} – electrical work done, kJ/kg.

Exergy loss in the expansion valve:

$$I_{\overline{exv}} = m_r(s_4 - s_3) \quad (7)$$

Coefficient of Performance:

$$COP = \frac{Q_e}{W_{el}} \quad (8)$$

Total exergy loss:

$$I_{IT} = I_{le} + I_{lc} + I_{lcp} + I_{lexv} \quad (9)$$

3. RESULTS AND DISCUSSIONS

The following results are obtained based on the below provided input data:

- condenser temperature: 15°C;
- electrical efficiency: 75%;
- ambient temperature: 27°C;
- R134a mass flow rate: 1 kg/s.

The evaporator temperature will vary in the range (-10 ÷ -2) °C.

In Figures 2 and 3 are depicted the influences of evaporator temperature increment on the Coefficient of Performance and on the total exergy loss.

From these representations it is obvious that evaporator temperature influences the indicators of performance of the analysed cycle.

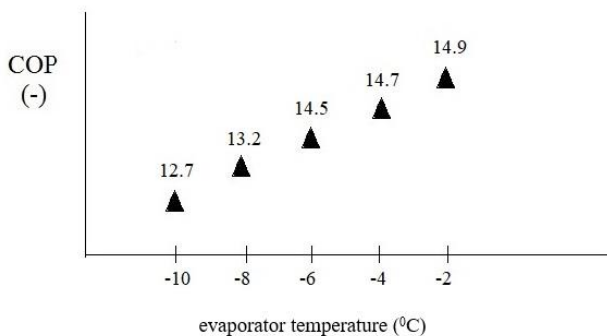


Figure 2. COP versus evaporator temperature

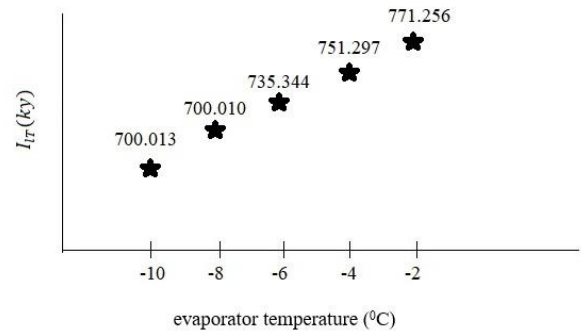


Figure 3 Total exergy loss versus evaporator temperature

The increase in the evaporator temperature leads to a better first law of thermodynamics efficiency (COP), but also to more important energy degradation.

When evaporating R134a at the highest considered temperature (-2°C), the Coefficient of Performance increases around 17%, but the energy degradation will also increase, with about 10%.

4. CONCLUSIONS

Marine refrigeration should be subject of energy efficiency improvement, especially in the present context.

First and second laws of thermodynamics are the main tools used in this thermodynamically approach.

Our theoretical thermodynamic study focused on a VCRS with no super heating and no sub cooling.

From this research results that evaporator temperature influences the values of the Coefficient of Performance and of the total exergy loss in the system. The increase of the evaporator temperature is found in the increase of the above-mentioned performance indicators. The analysis based exclusively on the first law of thermodynamics is not a realistic one, being needed also the application of the second law of thermodynamics.

The obtained results have shown that exergy analysis is an important tool when it is aimed the energy efficiency increase by diminishing the inefficiency in the refrigeration system.

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