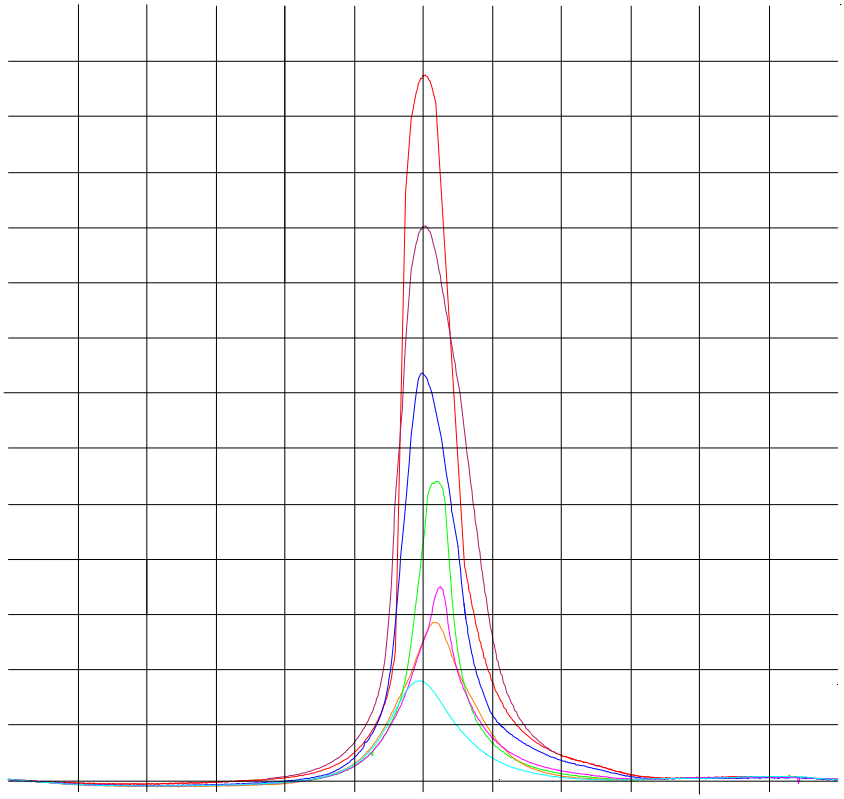
**CONSTANTA MARITIME UNIVERSITY**
**FACULTY OF NAVAL ELECTROMECHANICS**
**DEPARTMENT OF MECHANICAL ENGINEERING**

# RESEARCHES REGARDING THE POSSIBILITIES TO TREAT EXPLOSIVES TO OBTAIN FUEL FOR INTERNAL COMBUSTION ENGINES



SCIENTIFIC COORDINATOR:
PhD. Engineer Paul BOCĂNETE

PhD candidate:
Eng. Traian DORDEA

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## THESIS SYNOPSIS

**Chapter 1** is dedicated to the study of explosives (priming explosives, high explosives, powders and pyrotechnic mixtures ), in order to be able to perform a pertinent analysis of basic mixtures, of substances which provide energy, kindling temperature, burning speed and heat resulted from the explosion as well as other requisites needed to produce fuels for the internal combustion engines.

**Chapter 2** presents a multicriterial analysis of the explosives described in the first chapter; this analysis will help design the one that sums up the required properties to produce fuels for the spark ignition engines.

A comparative analysis was achived from the point of view of performances and we established ten criteria to take into consideration, as shown below:

1. explosive properties;
2. caloric power;
3. kindling point;
4. cost of raw materials;
5. production costs;
6. expenses to modify the vehicles expected to run on the newly designed fuels ;
7. expenses to ensure their proper storage;
8. expenses to ensure their distribution;
9. standing up in time in what concerns the effects of the atmospheric agents;
10. toxicity degree.

Sequel to determining the criteria weight and the calculus of the performance index for each of the criteria, it was established the ranking of the explosives which were proposed for the production of fuels for internal combustion engines, the first place being occupied by the trinitrate cellulose.

**Chapter 3** deals with the celulose properties, its chemical reactions, nitration procedures, nitrate cellulose properties and their use according to the nitration degree.

To be able to observe the cellulose and respectively trinitrate cellulose evolution in a system, a study of molecular dynamics was performed through the analysis of systems in Gabedit application and their optimization in MOPAC application .

**Chapter 4** renders a study of burning in the spark ignition engines which treats in detail the chemical reaction of burning, the establishing of the reaction speed, burning kinetics, dissociation of burnt gases and their influence on output as well as the parametres of the dissociated gas.

Within this chapter a study of the dissociation' s influence on the internal energy was achieved by a caloric calculus of the dissociated burning gases and theoretical thermal output of the engine cycles.

Also, having in view that the trinitrate cellulose is an explosive , this chapter presents a study concerned with the detonation in engines starting with the theory of detonation wave to the study of variation of the internal energy according to the equation of Hugoniot.

**Chapter 5** is the largest in the thesis and is dedicated to the assessment of the trinitrate cellulose input to the increase of the performances of fuels designed for spark ignition engines. This chapter also presents the equipment and methodology used in

testing the combustion mixtures based on nitrate cellulose and comparative results, as follows:

1. In the first part of this chapter is shown the way to obtain combustion mixtures and their componence.

2. Later on we present the study of combustion mixtures which allowed us to visialise in detail the samples, the homogenous degree and their stability in time. The study was actually performed in the Electronic Microscopy Laboratory in „Ovidius" University in Constanța with the optical microscope BioROM-T, with x4, x10, x16 lenses scanning microscope through emissions of electron stream CM 120 produced by Philips Co. that enabled an enlargement of images of 880.000.000 x.

3. To determine the influence of trinitrate cellulose on gasoline, the obtained mixtures were analysed in the Laboratory for the Chemistry of Naphta in the Oil and Gas University of Ploiesti with spectomentre IROX 2000 which highlighted the anti-detonation character of trinitrate cellulose by incresing the COR of the analysed mixture.

4. The determination of the COR was performed only for the solution of Naphta COR 70 gasoline, Bioethanol and trinitrate cellulose; this was performed in two locations, namely the laboratory Oil Terminal Constanța Co. and the laboratory of Petromidia Năvodari refinery on the stand with engine for the determining of the octane number CFR ASTM –Waukesha.

Within the determination stage it was found that a quantity of 4.8 grammes of trinitrate cellulose in a litre of mixture produced an increase of octane number from 97.3 CO/R to 102.5 CO/R.

5. The physico- chemical influences of the trinitrate cellulose were studied on an engine with a variable compression rate produced by GUNT Co. of type CT-152 to compression ratio of 10:1, 8,5:1 and an advance of ignition of $+40^0$ to achieve the conditions of burning with detonation.

6. The researches on the engine were focussed on the study and comparison of energetic parametres, by drawing up diagrams for the pressure of the admission gases, the pressure in respect with the rotation angle of the crankshaft and the variation of pressure in the burning chamber in respect to the occupied volume.

The tests were performed on the following fuels and their mixtures:

- gasoline COR 71 (Naphta)
- gasoline COR 71 + Bioethanol
- gasoline COR 71 + Bioethanol +trinitrate cellulose
- gasoline COR 98

7. From the comparative analysis of the energetic parametres of the engine the fuels and mixtures presented above it resulted that the mixture with trinitrate cellulose has superior energetic characteristics as compared to the others.

**Personal contributions**

Theoretical and experimental researches performed with a view to achieve the proposed objectives have shown a series of original contributions regarding :

- A complex study was achieved concerning the processes in the engines with spark ignition;
- A theoretical study on cellulose and explosives;
- With the help of multicriterial analysis a pertinent comparative analysis concerning representative explosives was achieved; this will enable the choice of an explosive with appropriate properties for the production of fuels meant for spark ingnition engines;
- Conceiving and optimization of combustion solutions based on trinitrate cellulose;
- The methodology of experimental research, acquisition techniques and processing of experimental data were presented in detail.
- The experimental research programme was drawn up for the mono-cylinder on which the tests were performed highlighting on the main energetic parametres.
- The experimental research of the influence of nitrate cellulose in different mixtures with gasoline concerned with the energetic parametres of engine CT 152 manufactured by GUNT Co.
- A comparative analysis of the effective parametres measured within the experimental research.

**6.2. Future research lines**

The results obtained so far during the research for the thesis enable us to foresee new research directions, such as:
- investigate nitrate cellulose as a potential energy resource for the spark ignition engines;
- analyze the energetic and ecologic performances of bio-fuels obtained from trinitrate cellulose in the case of using different ratios for supplying the spark ignition engines ;
- perform tests with mixtures of hydroxy-cellulose and bioethanol of low concentration.
- test trinitrate cellulose based fuels for comprassion rates higher than 10:1