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NUMERICAL ANALYSIS OF KNOCKING PROCESS IN A COOPERATIVE FUEL RESEARCH ENGINE USING ZERO DIMENSIONAL MODELS

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INTRODUCTION

This study consists in a built of a zero-dimensional representative model of a CFR (Cooperative Fuel Research) Engine in the software AVL - BOOST, with the aim of analyzing the behavior of combustion observing the phenomenon of autoignition. The fuels utilized in this study are mixtures of ethanol-containing gasoline surrogates. Remembering that knock its a phenomenal governing not only by the fuel but also by the chamber geometry [1]. Operation in engine knock can be considered as the limiting factor of a SI engine's thermodynamic efficiency [2].

OBJECTIVE

This study pretends to understand the effects of the variables of combustion in the phenomenal of knocking in internal combustion engines operating in the HCCI (Homogeneous Charge Compression Ignition) cycle, with blends of ethanol-containing multi-components gasoline surrogates.

MATERIALS AND METHODOLOGY

The model will have as fuel, blends of different proportions of ethanol and gasoline surrogates, it will have 4 chemical elements (iso-octane, n-Heptane, Toluene, di-iso-butylene) as proposed by reference [3] in their studies. The proportions of the Ethanol / Surrogates blends were taken from the reference [4] as shown in the figure below:

Table 1: Volume percent of components in each gasoline surrogate/ethanol blends - (v/v %). [4]

Blend	EtOH	*iso*-Octane	*n*-Heptane	Toluene	DIB
E0	0	33.3	24.4	27.8	14.4
E10	10	30.0	22.0	25.0	13.0
E20	20	26.7	19.6	22.2	11.6
E30	30	23.3	17.1	19.4	10.1
E50	50	16.7	12.0	13.9	7.2
E85	85	5.0	3.7	4.2	2.2
E100	100	0.0	0.0	0.0	0.0

EtOH = Ethanol, DIB = *di-iso*-Butylene.

The structure of the research will be based on an iterative process of comparison between simulated results and experimental results. Data as RON collected by reference [4] for each mixture, will be adopted in the models

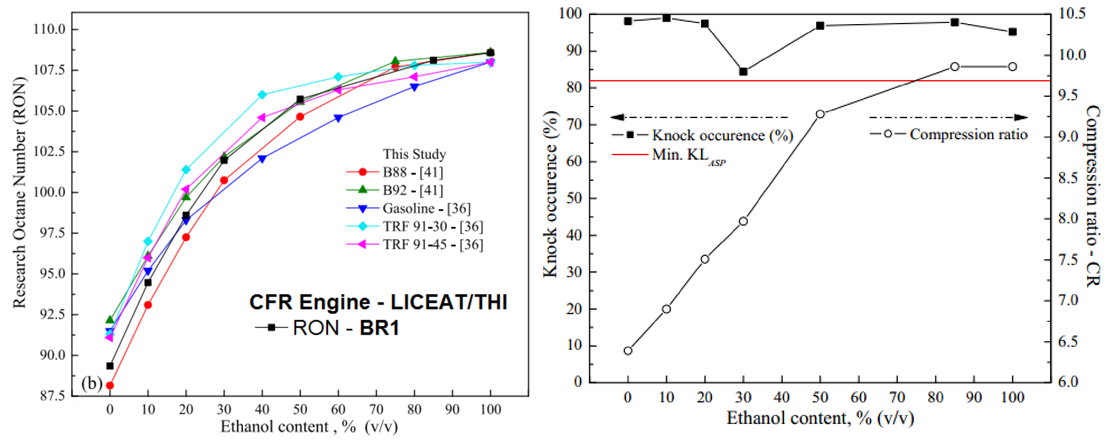

Figure 2: (a) RON comparison from this study and from literature. (b) The RO numbers of ethanol-containing gasoline surrogates [4]

EXPECTED RESULTS AND DISCUSSION

The study of this publication still in progress. The information about CFR Engine was taken in ASTM Standard Test Method: D2699 – 18, resulting in the zero-dimensional model in the picture below:

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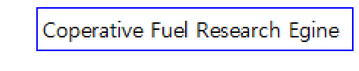

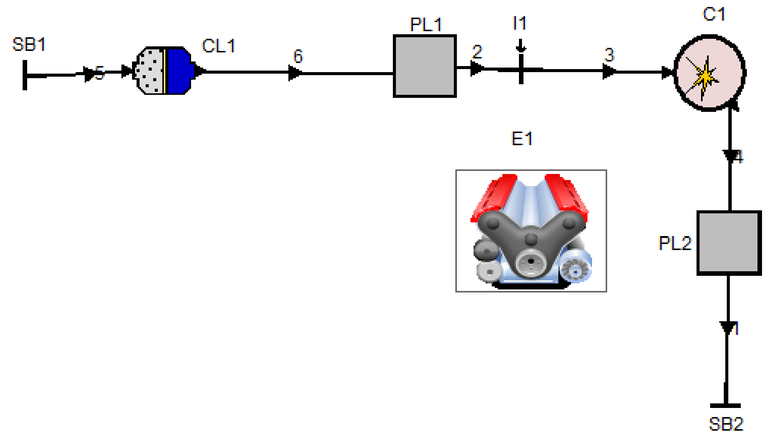

Figure 3: Zero-dimensional AVL-BOOST CFR Engine model.

The efforts at this time have been in analyzing the knock occurrence, and compare with the CFR experiment that reference [4] collected in his study. To get more reliability, the pressure curves of the combustion was integrated with de combustion of the engine model.

CONCLUSION

The focus of the study after validating the model, it will be in studying small changes on the other variables and their impact in knocking parameters.

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