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NUMERICAL SIMULACION OF A FOUR-CYLINDER SPARK IGNITION ENGINE USING ETHANOL-BASED GASOLINE SURROGATES

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INTRODUCTION

As time passes the technology advances, and with it, new designs of internal combustion engines by spark are necessary. Experimental data is used in combination with experimental data in order to develop numerical models for combustion systems. For internal combustion engines, the detailed kinetics models that represent the combustion process play a very important role. Figure 1 shows the more common cycle of research and development in combustion process.

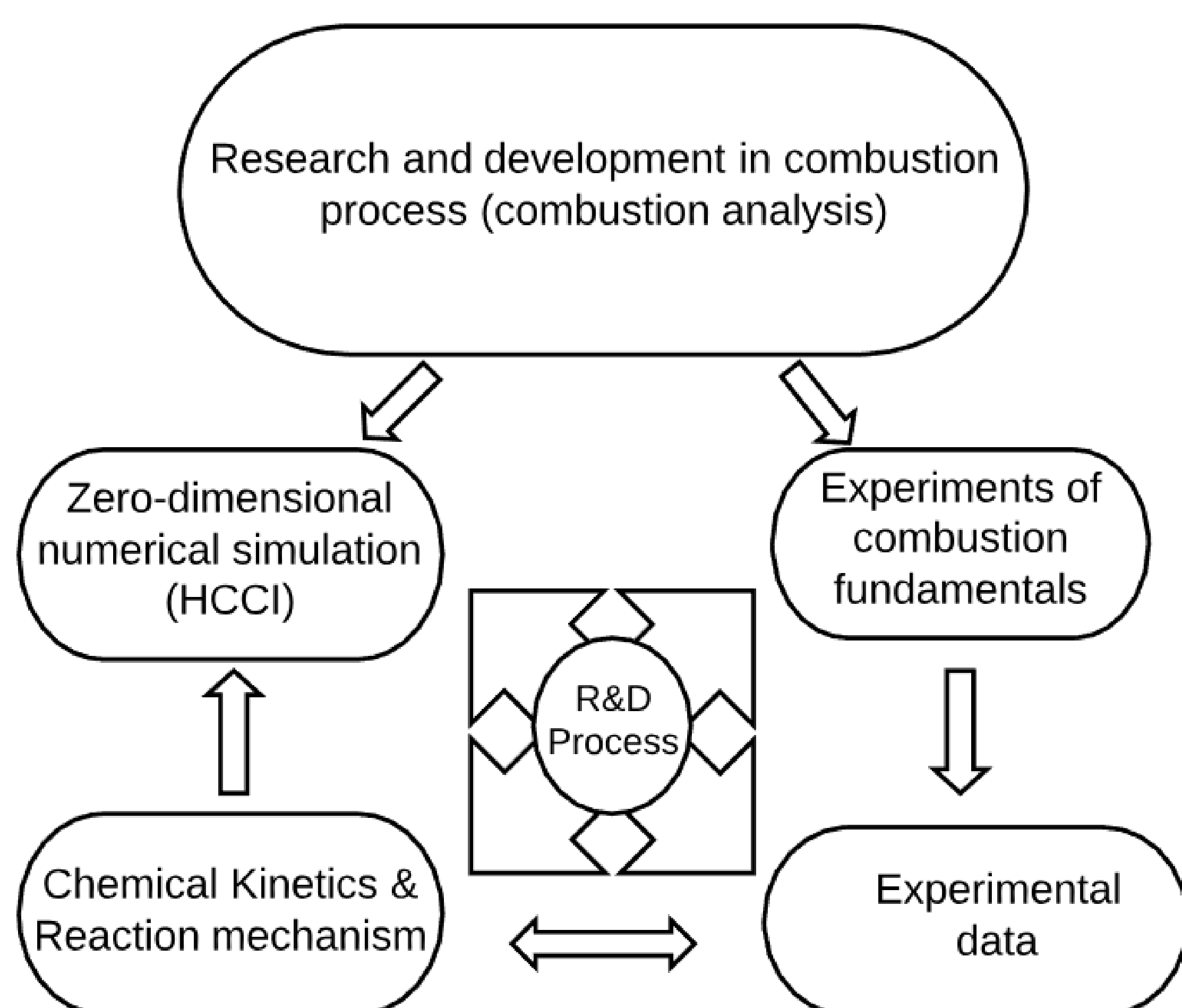


Figure 1. Typical research and development cycle in combustion process

OBJECTIVE

In this study ethanol-based gasoline surrogates [1] are used as fuel in numerical simulations using zero-dimensional models in AVL-BOOST software. The main focus is to numerically assess the detailed kinetics model of ethanol-based gasoline surrogates when used for engine simulations. Experimental data from dynamometric bench will be used as validation parameter.

MATERIALS AND METHODOLOGY

For the realization of the simulations the following zero-dimensional model of a commercial 4-cylinder engine will be used, where the results will be obtained as: torque curve, power curve and efficiency, to make comparisons with the experimental data obtained from the engine test of dynamometer bench.

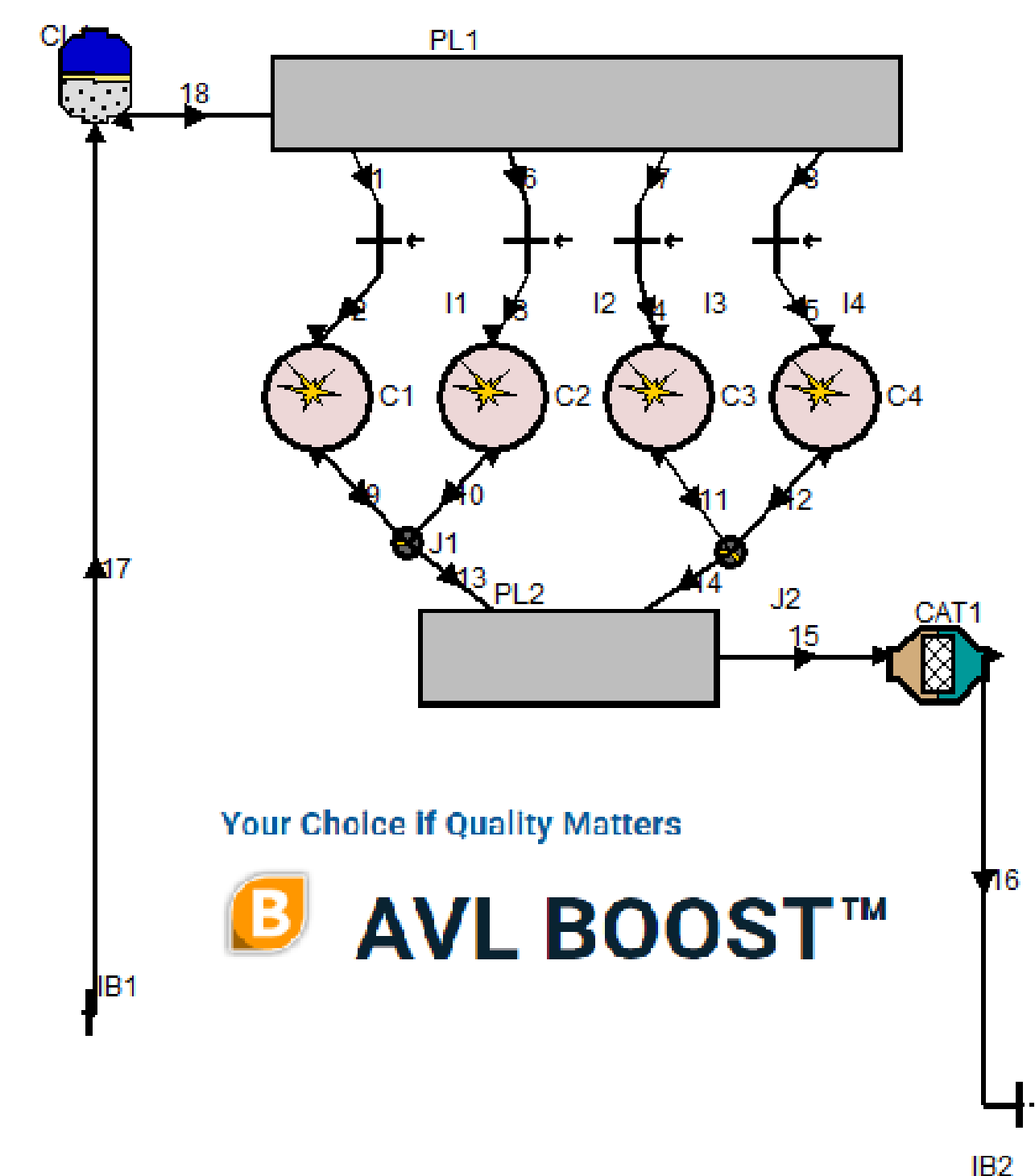


Figure 2: AVL-BOOST four-cylinder engine model.

EXPECTED RESULTS AND DISCUSSION

Numerical simulation, and with the support of experimental data, will return the validation process of the detailed kinetics model for ethanol-based gasoline surrogates, when tested in virtual internal combustion engines. It should be possible to analyze the behavior of the mixture with the amount of fuel percentage when added to ethanol. Figure below shows experimental data of ignition delay times and octane numbers for several ethanol percentages of that mixture are already available from our research group.

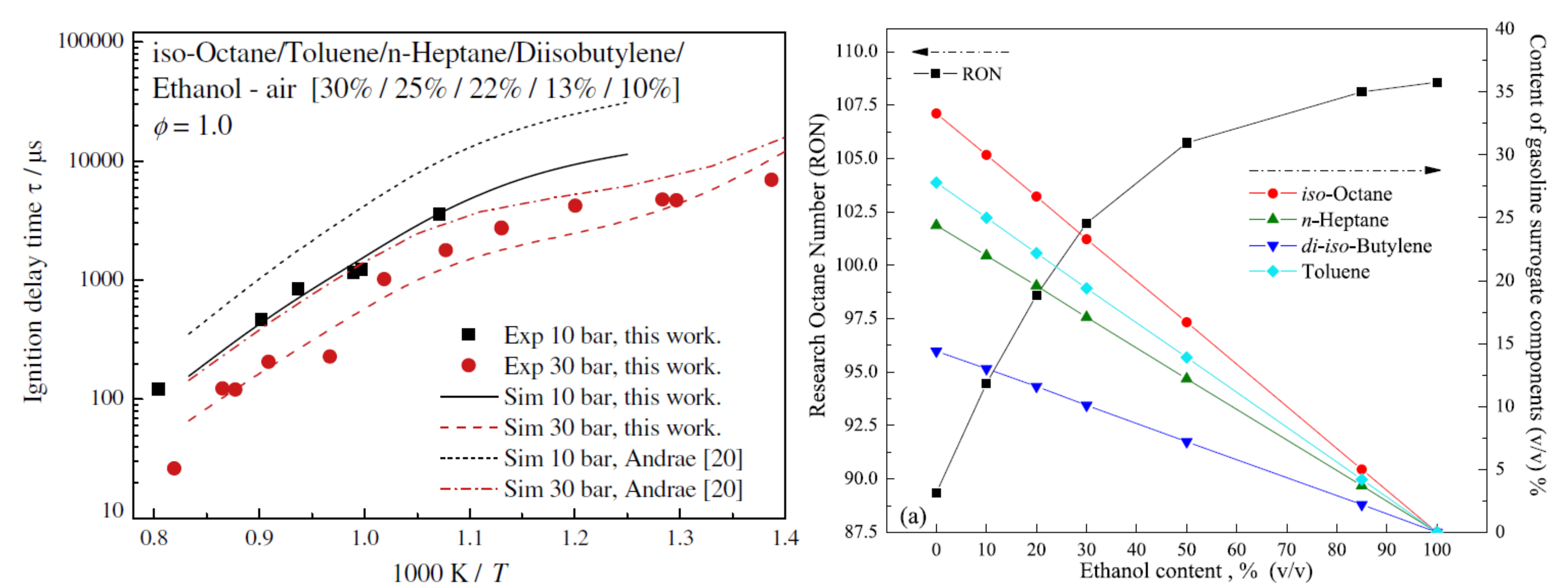


Fig 3. IDT experiments in HPST [1] and RON measured in CFR engine [2]

CONCLUSION

The engine model from this work, and the experimental data obtained from a parallel work in our research group, will be used for the development of an relationship between the Anti Knock Index (AKI) and Ignition Delay Times (IDT), useful for advanced engines developments as HCCI technology.

REFERENCES

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- [2] A. da Silva Jr, J. Hauber, L.R. Cancino, K. Huber. The research octane numbers of ethanol-containing gasoline surrogates. *Fuel* 243 (2019) 306–313. <https://doi.org/10.1016/j.fuel.2019.01.068>.

