

ZND detonation of hydrogen-oxygen mixture

Magorzata GRZMIACZKA

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1 Introduction

ZND detonation model is one-dimensional model, with no transport effects, for the processes of detonation. It was developed by Zeldovich von Neumann and Doering in 1944.

Model considers detonation two consist of two parts: leading shockwave and chemical reaction zone.

ZND model forms a connection between detonation cell zone and the induction time, which is going to be computed.

Calculations were made for hydrogen-oxygene mixture.

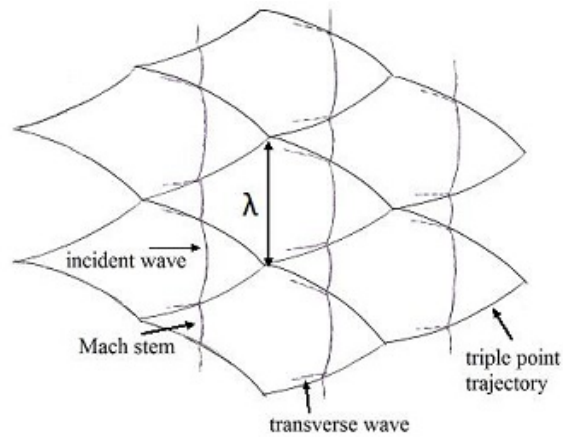


Figure 1: Detonation front structure

2 Mathematical model

ZND code has been downloaded from Caltech website, it's program calculating simple detonation, has been published for the first time in 1944.

3 Results

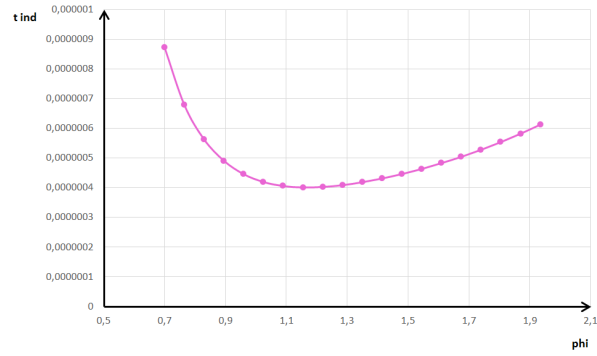


Figure 2: Induction time dependence - ZND calculation

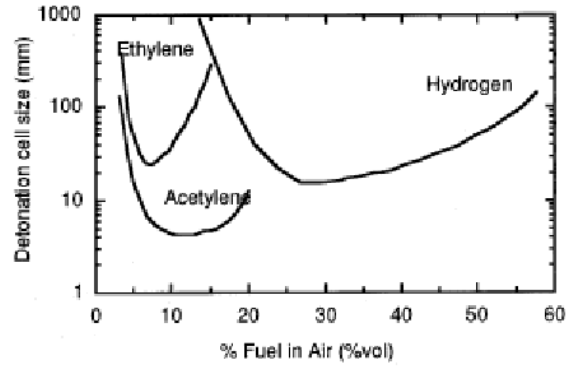


Figure 3: Experimental data

The shape of these two charts almost coincide because of the equation, that shows the relation between induction time and cell size:

$$a = \frac{t_{ind}}{\lambda} = \frac{7,77 * 10^{-8}}{0,0121} = 6,45 * 10^{-6} \quad (1)$$

4 Summary

As it can be seen on Figures 2 and 3, calculations for ZND detonation are very close to experimental data. The induction time, might be measured in s^{-8} . High values of velocity of detonation are the reason for calling the experiment Knallgas.

5 References

1. https://en.wikibooks.org/wiki/Engineering_Acoustics/Detonation, [access: 07.06.2017]
2. <http://shepherd.caltech.edu/EDL/public/cantera/html/SDToolbox/>, [access: 07.06.2017]
3. <http://oaktrust.library.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-2010-05-395/NAKAMURA-THESIS.pdf?sequence=2>, [access: 07.06.2017]
4. https://en.wikipedia.org/wiki/ZND_detonation_model, [access: 07.06.2017]