Basic macros Compatibility with language.def Hooks Defining babelensure Macros for setting language files up Shorhands Language attributes Macros for saving definitions Short tags Hyphens Multiencoding strings Macros related to glyphs Bidi layout Input engine specific macros

Redefinitions for bidi layout Bidi footnotes Creating languages and reading ini files Hyphen rules for 'canadian' set to "l@english ("language0). ReportedHyphen rules for 'australian' set to "l@ukenglish ("language21). ReportedHyphen rules for 'newzealand' set to "l@ukenglish ("language21). Reported

english

Determining the effect of inert gas on explosive limits

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Computer Methods in Combustion

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Warsaw, 14.06.2022

Contents

1 Introduction

The project presents the result of explosive limits calculation of hydrogen and air mixture using Cantera. During the project the effect of nitrogen as an inert gas on those limits has been examined.
Initial parameters has been presented:

1. Constant:
    - ignition temperature = 1000 [K]
    - initial pressure = 1 [atm]
    - volume
2. Varying:
    - equivalence ratio
    - nitrogen to oxygen ratio

2 Model

The program simulates a zero-dimensional chamber with constant volume. For the calculations no heat losses were assumed. The program calculates the range of equivalence ratio for which an explosion occurs. It uses a function that counts the explosion pressure, and then repeats the calculation for different molar ratios of nitrogen. It increses the equivalence ratio and checks for each the retoourned pressure value. When the pressure value is 1.05 times bigger than the inertial pressure it marks the lower explosion limit. It increses continuously the equivalence ratio value but this time when the returned pressure value drops below 1.05 the value of initial pressure it marks the upper explosion limit. It then repeats the scheme for other higher nitrogen to oxygen ratio values. Thats how the plot of the lower and upper explosion limit has been made.

3 Results

A plot of explosive limits is shown on Figure 1:

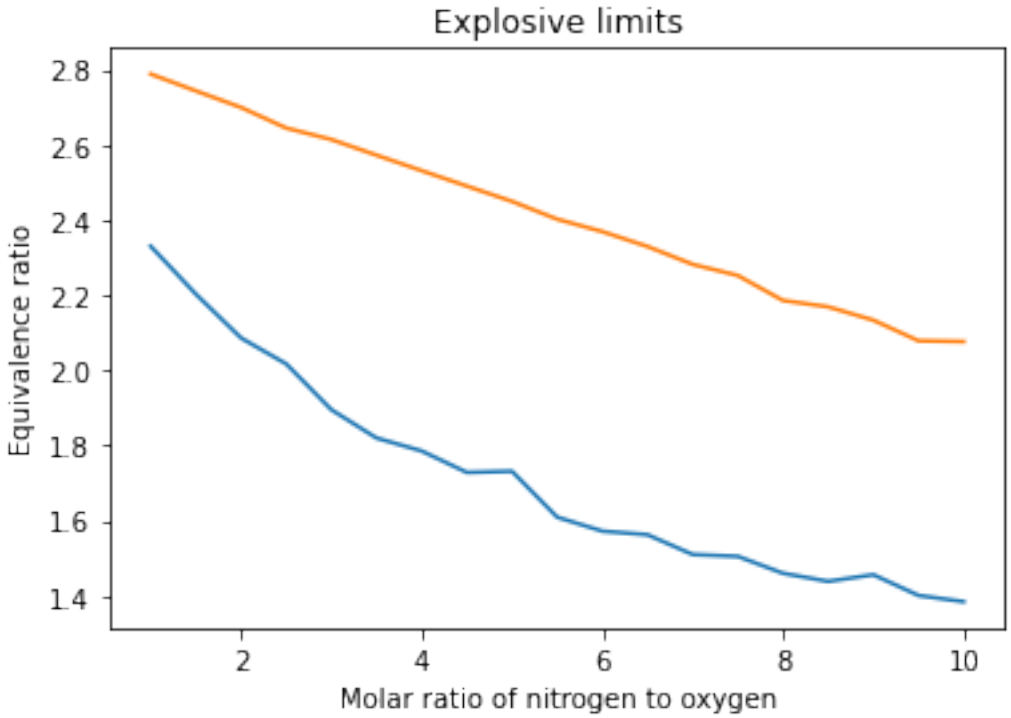

Figure 1: Explosive limits chart. Upper limit $\phi_{upper} = 3.5$, lower limit $\phi_{lower} = 1$.

The field between the upper and lower limits is the range for which the mixture is explosive because the program retourned the value of maximum pressure 1.05 times bigger than the inertial pressure.

4 Conclusions

The purpose of this report was to examine the effect of nitrogen as an inert gas on the explosive limits. The results show that for higher molar ratio of nitrogen to oxygen the equivalence ration tends to decrease. It occurs for upper limit as well as for the lower limit. However it occurs that the range tends to broaden due to the fact that the lower limit decreases faster than the upper. The similar experience has been found (nr. 4 in References) where the results are quite similar. However in their experiment the lower limit does not decrease this much and is much more steady.

5 References

1. Kamil Maciejczyk. Analysis of the adiabatic temperature and the temperature with constant volume in hydrogen air mixture combustion with different initial conditions.

2. Dominik Nurkowski. Mixture of hydrogen and oxygen combustion in air and in oxygen comparison.

3. Wojciech Rudy. Laboratorium Spalania - parametry wybuchowości.

4. http://conference.ing.unipi.it/ichs2005/Papers/120001.pdf