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METODY KOMPUTEROWE W SPALANIU

Differences between combusting hydrogen in air and pure oxygen

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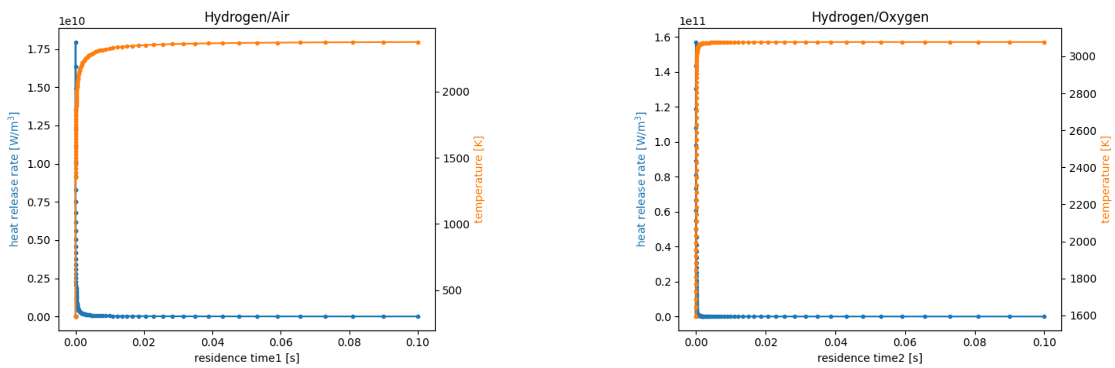
1 Introduction

The main task of this project will be to show differences between combusting hydrogen using two different oxidisers - air and pure oxygen. Simulations will include different equivalent ratios, and in some cases wider variation of pressures and temperatures at the begining of reaction. The effects of calculations are showed on graphs in the next paragraph.

2 Simulations and graphs

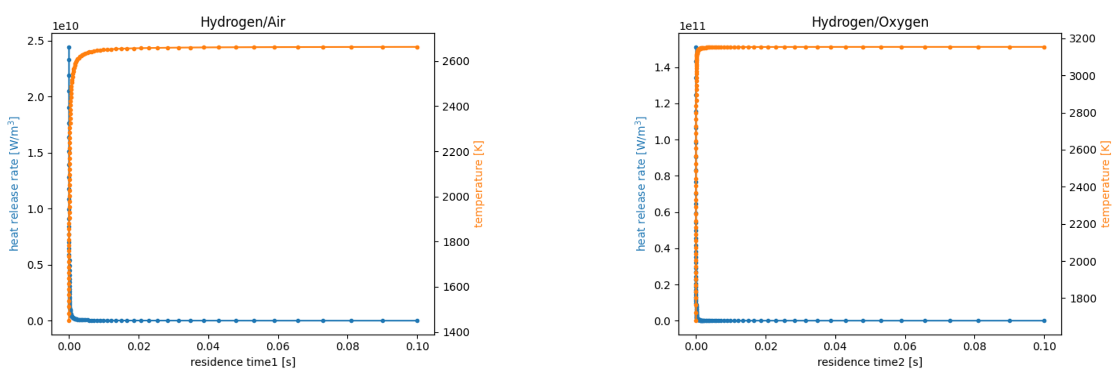
2.1 Equivalence ratio = 1

2.1.1 Temperature = 300 K; Pressure = 101325 Pa



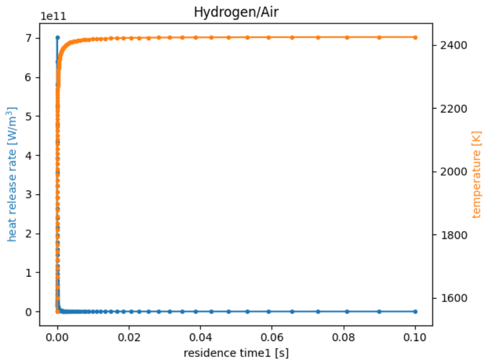
(a) Air (b) Oxygen

2.1.2 Temperature = 950 K; Pressure = 101325 Pa

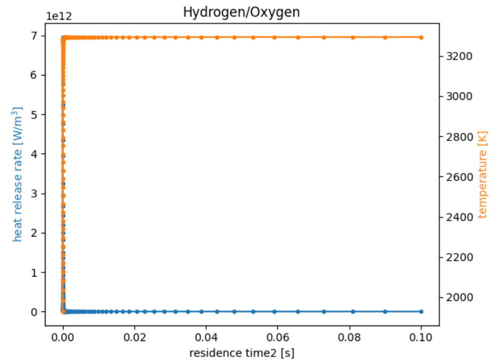


(a) Air (b) Oxygen

2.1.3 Temperature = 300 K; Pressure = 500000 Pa



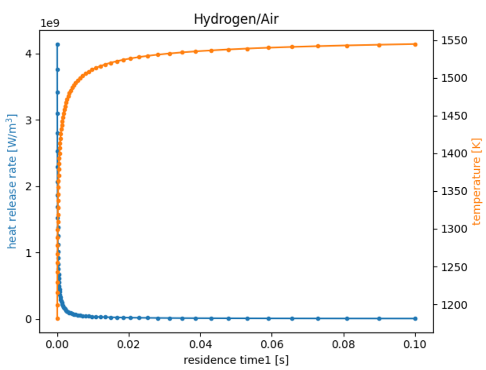
(a) Air



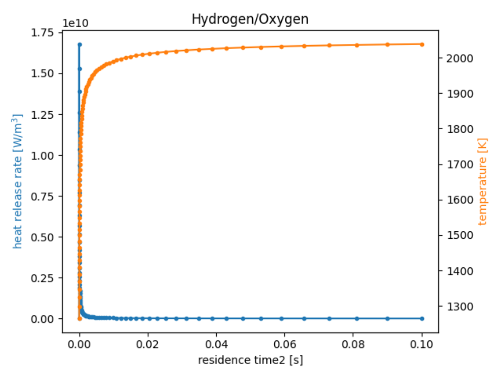
(b) Oxygen

2.2 Equivalence ratio = 4

2.2.1 Temperature = 300 K; Pressure = 101325 Pa



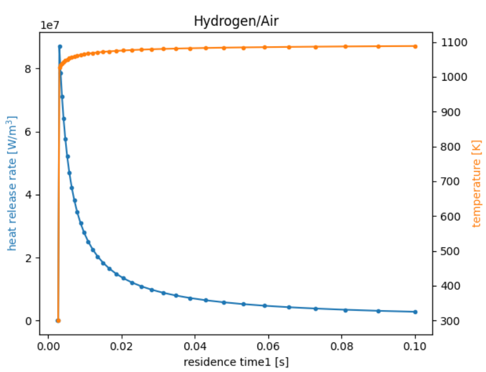
(a) Air



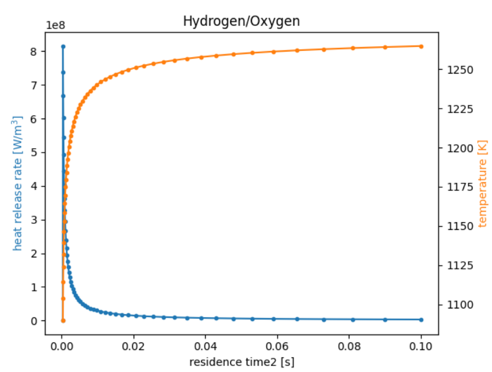
(b) Oxygen

2.3 Equivalence ratio = 8

2.3.1 Temperature = 300 K; Pressure = 101325 Pa



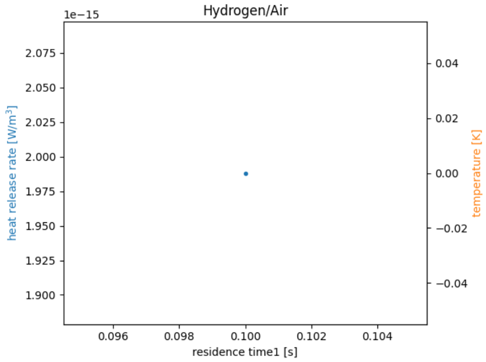
(a) Air



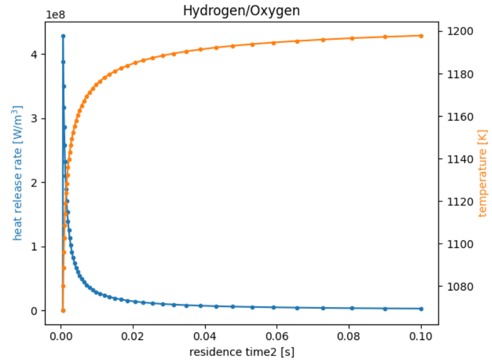
(b) Oxygen

2.4 Equivalence ratio = 8.66

2.4.1 Temperature = 300 K; Pressure = 101325 Pa

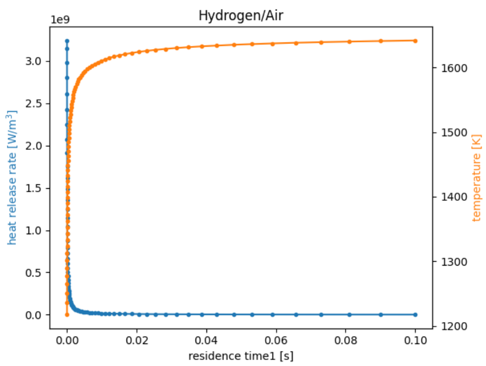


(a) Air

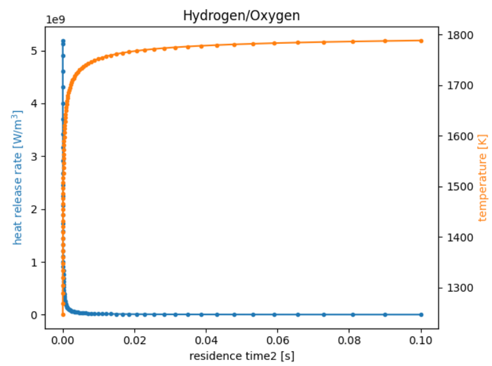


(b) Oxygen

2.4.2 Temperature = 950 K; Pressure = 101325 Pa

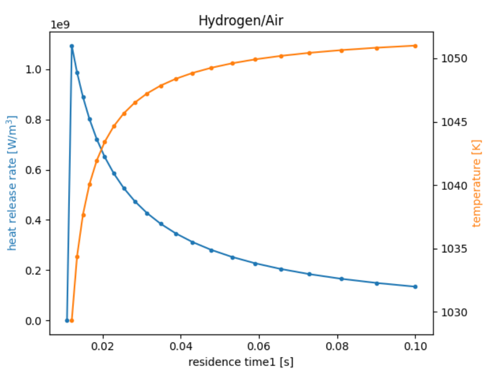


(a) Air

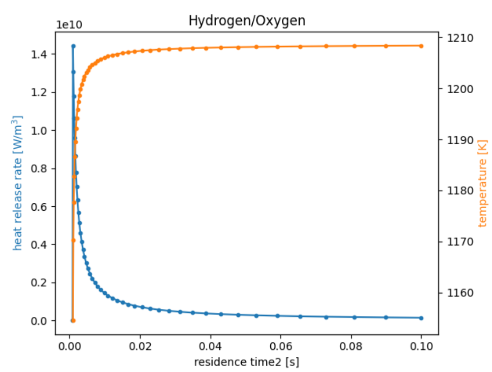


(b) Oxygen

2.4.3 Temperature = 950 K; Pressure = 5000000 Pa



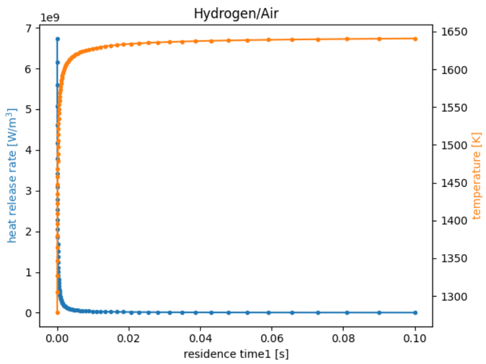
(a) Air



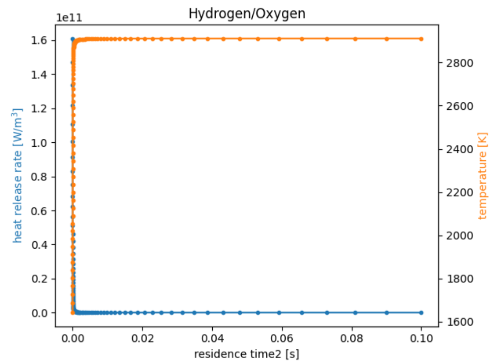
(b) Oxygen

2.5 Equivalence ratio = 0.5

2.5.1 Temperature = 300 K; Pressure = 101325 Pa



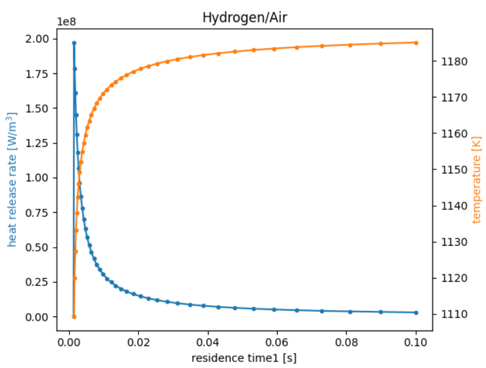
(a) Air



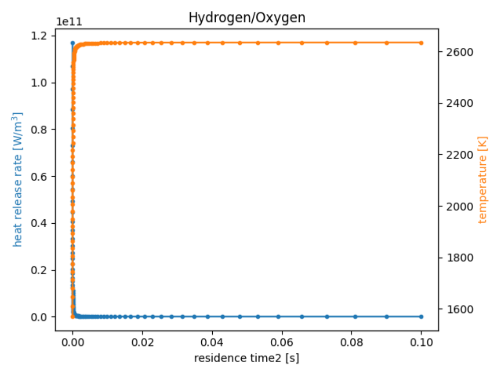
(b) Oxygen

2.6 Equivalence ratio = 0.3

2.6.1 Temperature = 300 K; Pressure = 101325 Pa



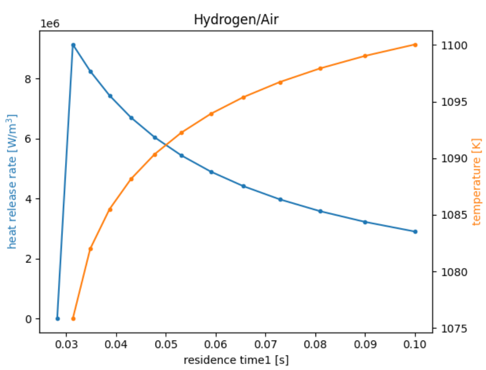
(a) Air



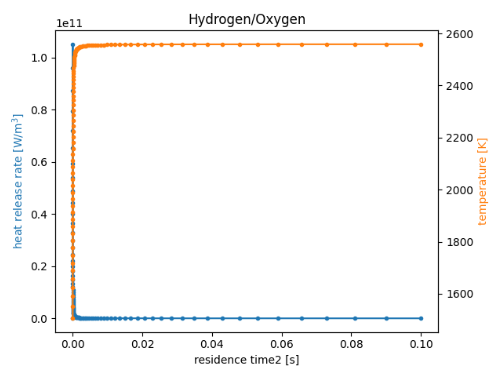
(b) Oxygen

2.7 Equivalence ratio = 0.27

2.7.1 Temperature = 300 K; Pressure = 101325 Pa



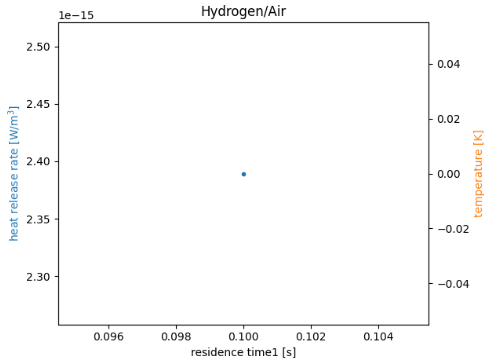
(a) Air



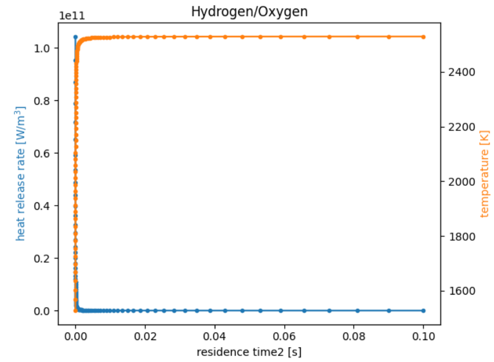
(b) Oxygen

2.8 Equivalence ratio = 0.26

2.8.1 Temperature = 300 K; Pressure = 101325 Pa

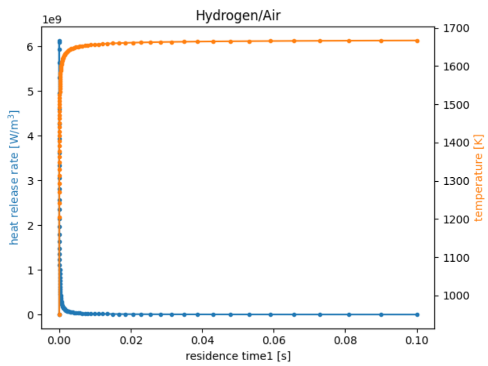


(a) Air

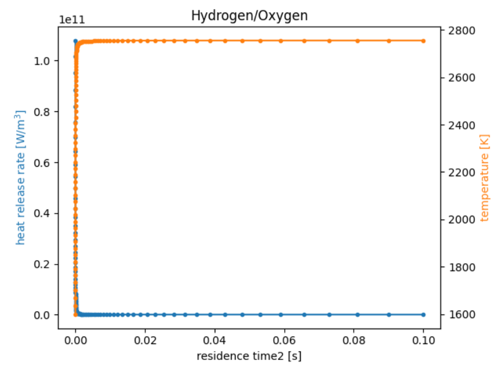


(b) Oxygen

2.8.2 Temperature = 950 K; Pressure = 101325 Pa

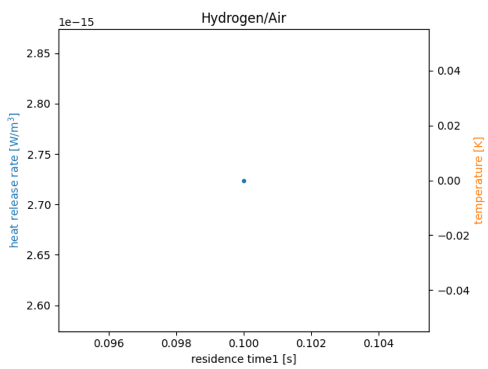


(a) Air

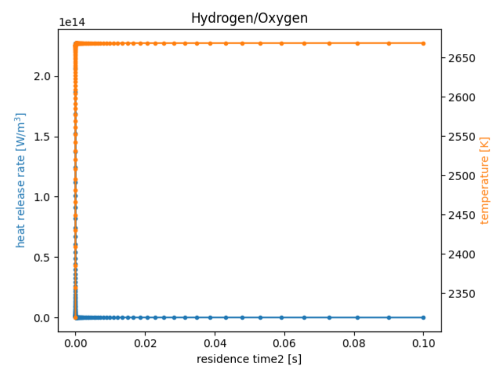


(b) Oxygen

2.8.3 Temperature = 300 K; Pressure = 5000000 Pa

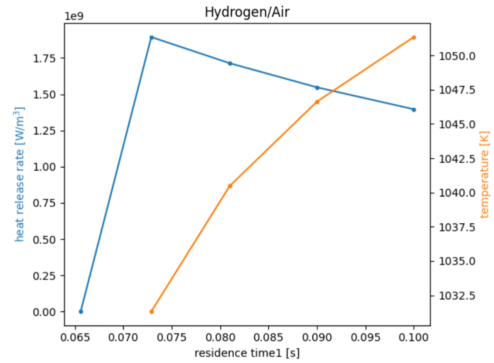


(a) Air

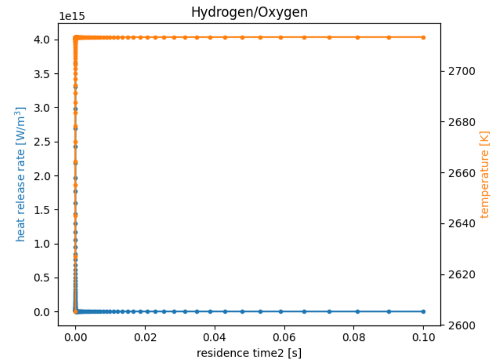


(b) Oxygen

2.8.4 Temperature = 300 K; Pressure = 50000000 Pa



(a) Air



(b) Oxygen

3 Conclusion

After analysis of graphs depicted above, there are several concludions.
- Basing on extreme equivalent ratios, which are 8.66 and 0.26, it can be seen that hydrogen has an upper and bottom limit of combustion in the air.
- The limits of combustion can be overcome to some degree by increasing the temperature or pressure of the mixture.
- To overcome the bottom limit of combustion by pressurizing the mixture, there is a need to greatly increase the pressure, comparing to the upper limit. In fact pressure needs to be an order of magnitude higher than this of mixture with equivalent ratio of 8.66.
- As it can be seen on graphs in paragraph 2.1, increase of temperature or pressure of the mixture increases heat release rate aswell as temperature of combustion.
- By comparing combustion of hydrogen in atmospheric air and in pure oxygen, it can be seen that there are several differences between reactions. Combustion of mixture with oxygen takes place in higher temperatures. Also mixture of hydrogen and oxygen has wider limits of combustion than this of hydrogen and air.