Gasification of RDF in two-stage reactor unit, comparison of two reactor configurations

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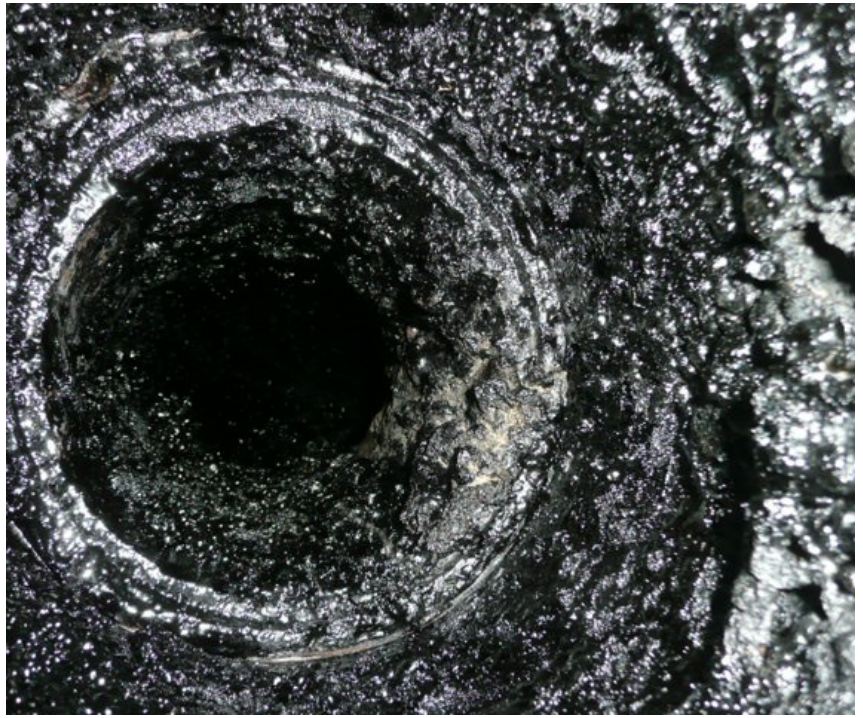
Introduction

- RDF – Refuse derived fuel
- Gasification – syngas production
- Tars – undesired product

RDF characterisation

Ultimate analysis (wt. %)			Proximate analysis (wt. %)	
N	1,4		Ash	10
C	52		Moisture	4
H	8,2		Volatile matters	81
S	0,22		Fixed carbon	6
O	28			
Cl	0,72		LHV (MJ/kg)	21,3



Goals

- Comparison of 2 reactor configurations
- Syngas composition
- Tar yields

Materials and methods

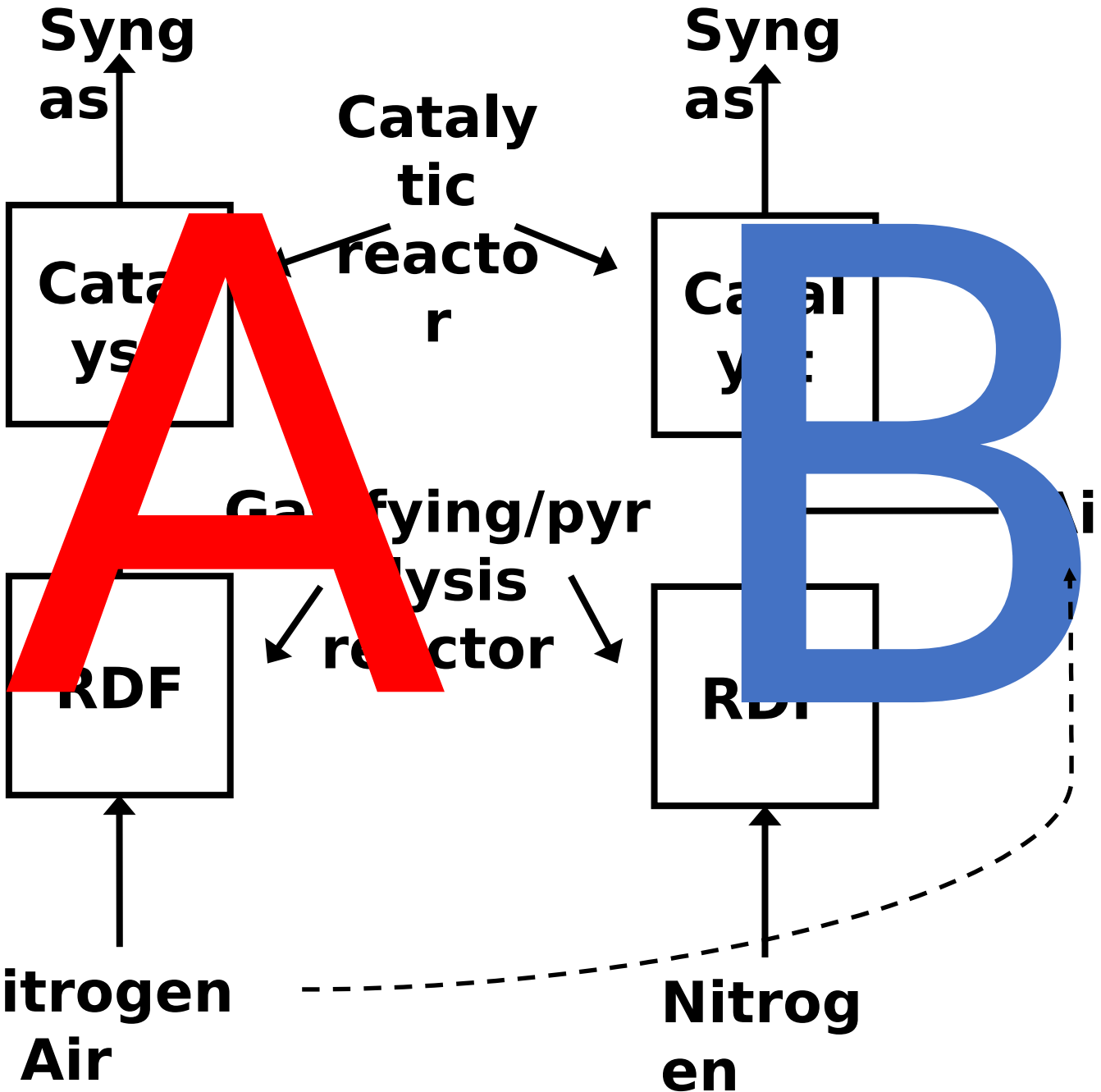
- Idea: partial oxidation zone:

air + volatiles = high temperature

=> lower tar content in syngas

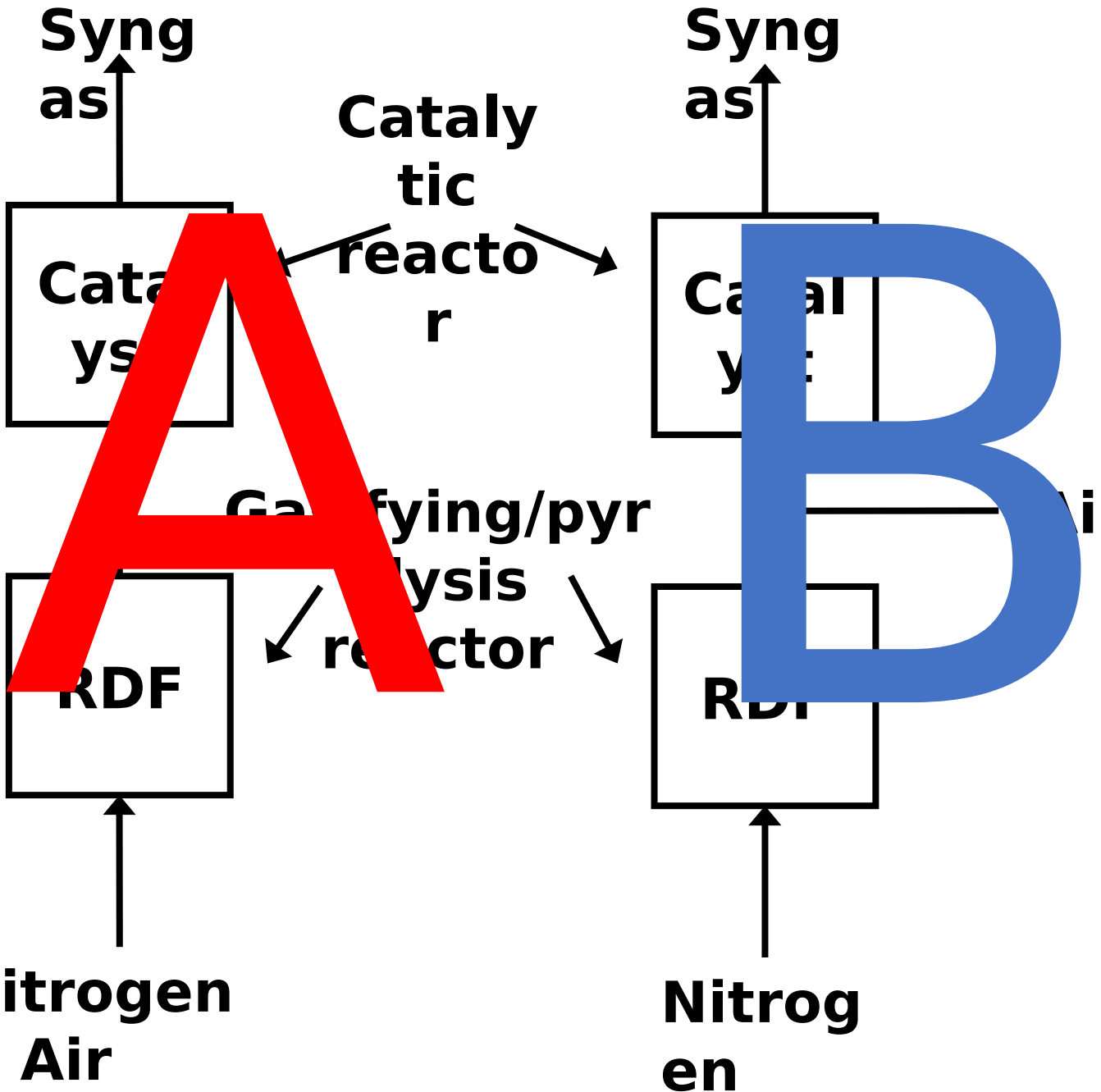
Configuration A

Configuration B

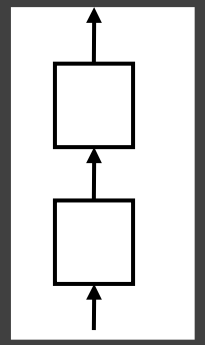


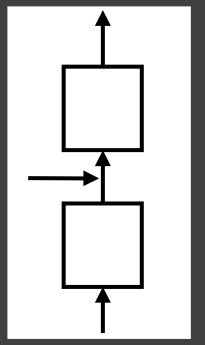
Materials and methods

- Semibatch process:
  10 g sample of RDF,
  10 g catalyst,
  15 L/h N_2,
  10 L/h air.
- Operating conditions:
  temperature of reactors – 700, 750 and 800 °C,
  preheated catalytic reactor,
  preheated furnace for gasifying/pyrolysis reactor.
- Catalyst: clay based catalyst enhanced by nickel oxide
- Syngas composition (sampled at the 5th minute)
- Tar yields – determined by vacuum distillation (10 kPa, 55 °C) and drying



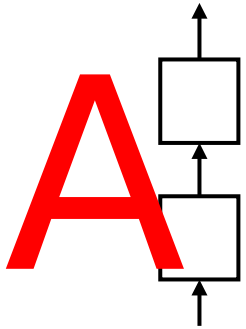
Results

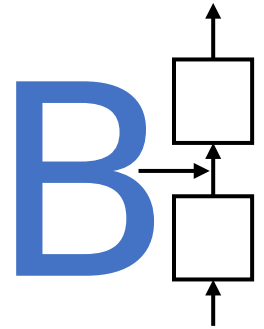




	Configuration A			Configuration B		
Temperature (°C)	700	750	800	700	750	800
	Gas Composition (vol. %)					
CO_2	38,8	38,7	36,9	40,9	27,1	17,3
H_2	27,8	25,0	18,2	24,5	31,2	41,0
CO	11,2	17,6	35,1	11,4	17,0	34,0
Methane	8,2	4,8	3,0	11,5	11,1	4,6
Hydrocarbons	14,0	14,0	6,9	12,4	13,7	2,9
Tar yields [mg/g RDF]	15,4	14,4	9,19	15,5	14,4	5,61

Conclusion





- Effect of partial oxidation on tar yields was obscured by activity of catalyst at 700 °C and 750 °C
- At 800 °C was observed drop of tar yield (comparison of configurations) and CO_2 and increased volume content of H_2
- Nickel oxide reduction by H_2
- H_2/CO ratio above 2 at 700 °C
- Pyrolysis coke – utilisation

Thank you for your attention