Pulsed compression:
advanced technology for high temperature, high pressure processes

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Introduction

A fundamentally new reactor has been developed.

- Very energy effective:
  - ✓ T of plasma chemistry and P of high-pressure technology for 'free'
  - ✓ low reactor temperature
- Very compact:
  reactor volume 10^3 – 10^4 times smaller than that of conventional reactors
- Very cost effective:
  - ✓ no high temperature/pressure equipment
  - ✓ no catalyst
  - ✓ simple design

Reactor concept

Is based on the principle of reversible compressive heating and cooling by a reciprocating piston, Fig. 1.

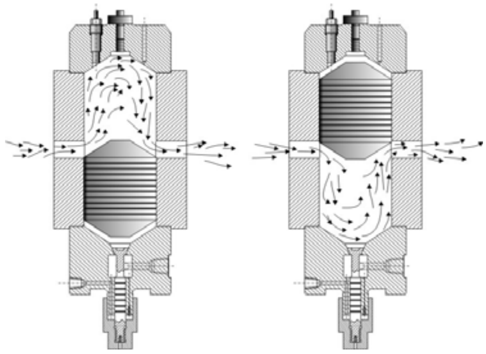

Fig. 1. Reactor principle; two limiting positions of the reciprocating piston are shown.

- No piston rings; gas bearing and labyrinth sealing.
- The reciprocation is maintained by reaction heat.
  For endothermic reactions – external energy source.

Experiments and results

Reactor with inner diameter of 60 mm, Fig 2.
Experiments with different hydrocarbon (gaseous and liquid) - air mixtures.
The feasibility was demonstrated for synthesis gas (H_2, CO) production (Fig. 3) and air cleaning. The reactor T was 200 – 400 ^oC in contrast with 800 – 1500 ^oC .

Fig. 2. Reactor inside frame.

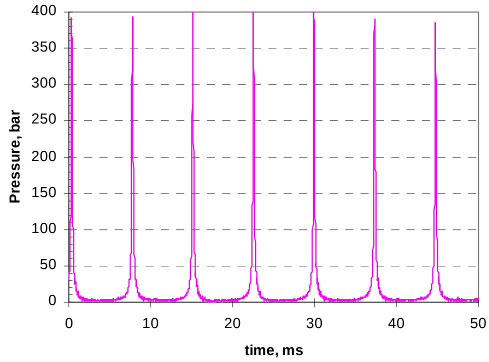

Fig. 3. Pressure in the reactor: production of syngas from propane and air. Reaction T ~ 3000 ^oC.

- Piston frequency — 200 Hz
- Reaction time — < 10^{-4} s
- GHSV — 10^7
- Compression ratio — 50
- T and P change rates — 10^7 K/s, 10^7 bar/s

Application

Very large *P-T* area can be covered by the pulsed compression technology, Fig.4

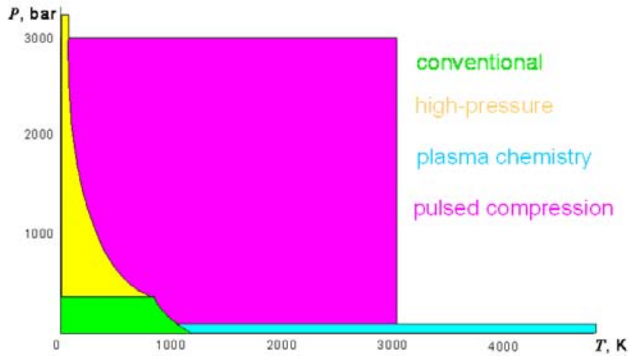

Fig. 4. P-T scopes covered by different technologies.

The most promising applications of the reactor are:

- syngas from various gaseous, liquid and solid hydrocarbons
- acetylene, ethylene, carbon black by (hydro/oxy) pyrolysis of hydrocarbons
- nitric oxide, nitric acid, hydrogen cyanide, etc.
- air cleaning by thermal destruction
- carbon-based nanoparticles – fullerenes, carbon nanotubes, etc.
- ultrafine ceramic and metallic nanoparticles by thermal decomposition of appropriate precursors

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