Coal characterization with use of drop tube test facility

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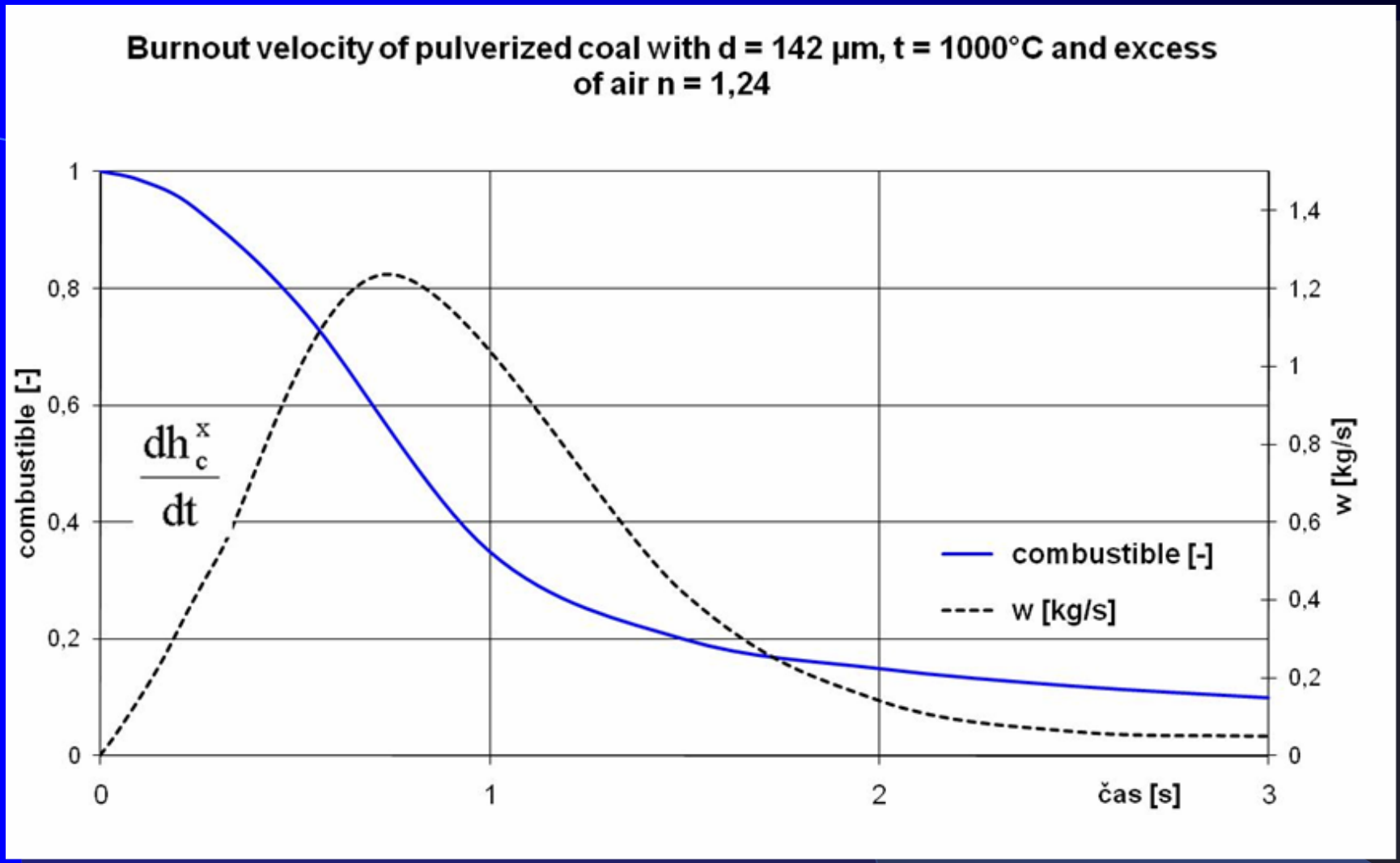
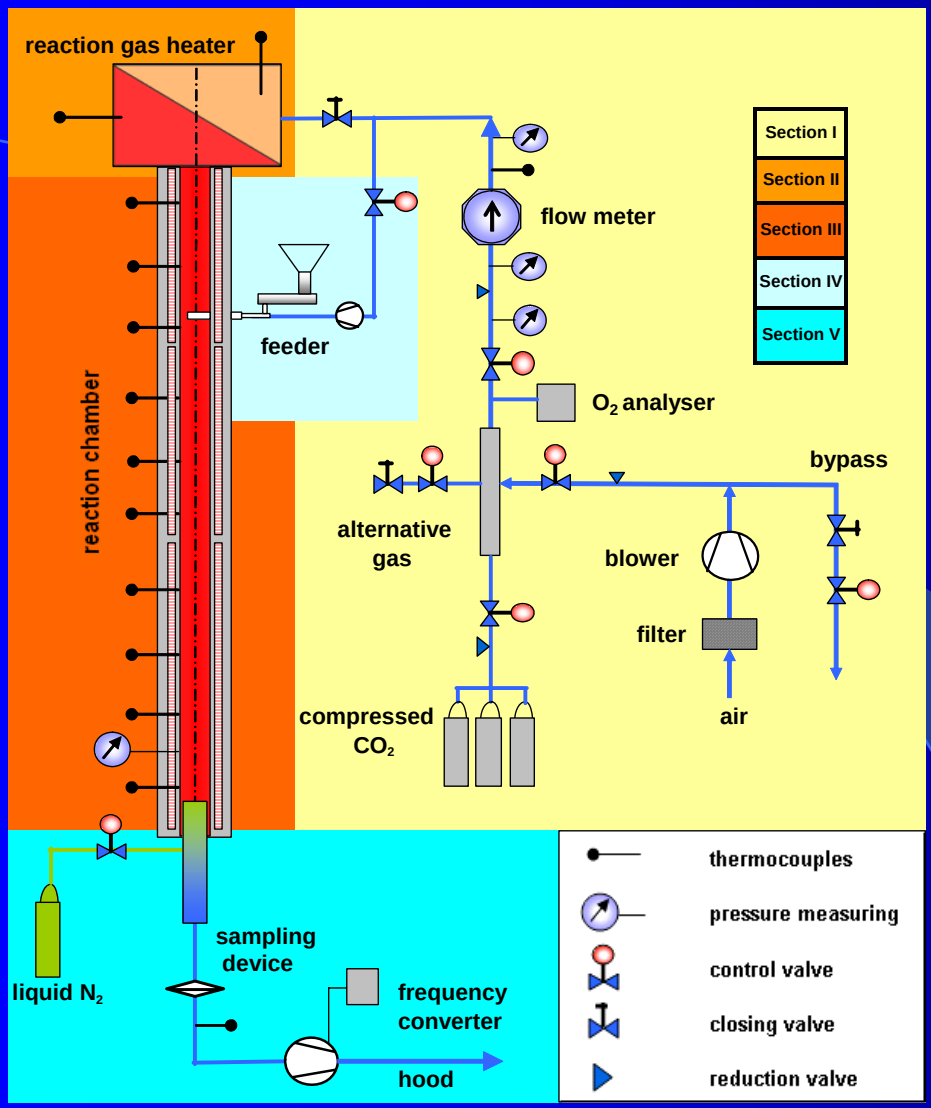

Burnout velocity of pulverized coal with d = 142 µm, t = 1000°C and excess of air n = 1,24
combustible [-]
w [kg/s]
čas [s]
$\frac{dh_c^x}{dt}$
combustible [-]
w [kg/s]
0
0,2
0,4
0,6
0,8
1
1,2
1,4
0
1
2
3

Thermokinetic properties of pulverized coal

Arrhenius equation

$$k = Ae^{-E_a / RT}$$

Drop tube


reaction gas heater
Section I
Section II
Section III
Section IV
Section V
flow meter
feeder
reaction chamber
O_2 analyser
bypass
alternative gas
blower
filter
compressed CO_2
air
thermocouples
pressure measuring
control valve
closing valve
reduction valve
sampling device
liquid N_2
frequency converter
hood


Linde
1977
KAPALNÝ DUSÍK

Parameters of ERC drop tube

- 5 m long reaction chamber, 66 mm inner diameter
- Temperature in reaction chamber up to 1200 °C
- Reaction gas velocity 1 – 4 $m.s^{-1}$
- Concentration of oxygen 0 – 21 %

- **4 degrees of freedom**

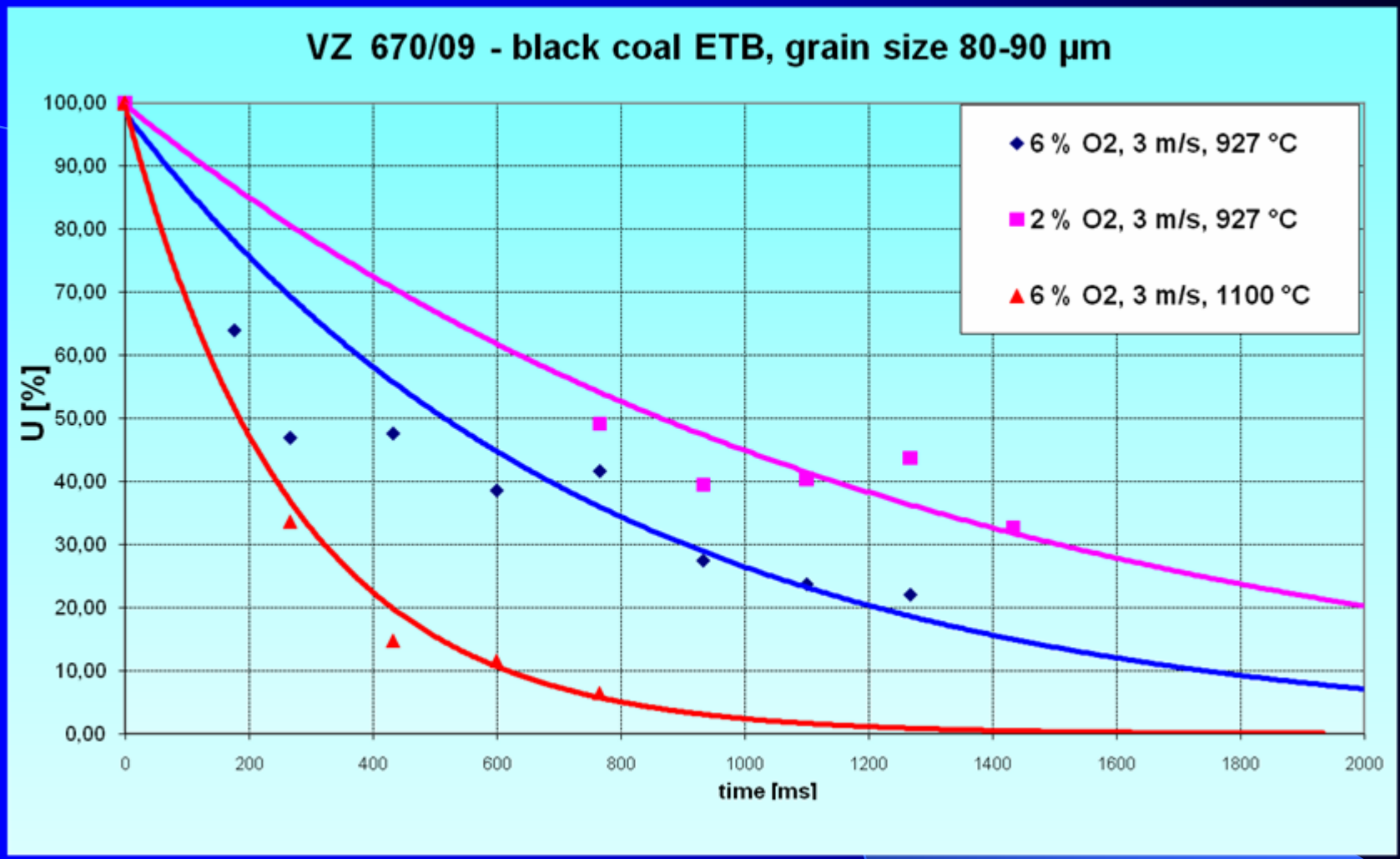
  1. **Reaction gas temperature**
  2. **Concentration of oxygen**
  3. **Reaction gas velocity**
  4. **Sample grain size**

- **Time-consuming and expensive tests and analyses**

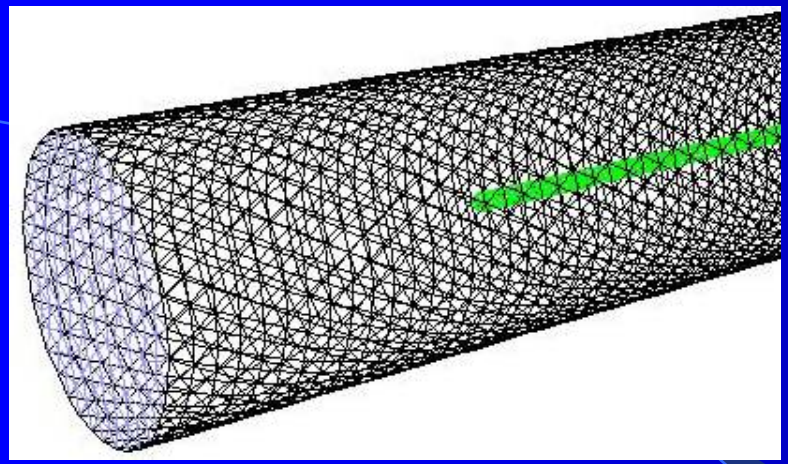
Input parameters of used sample

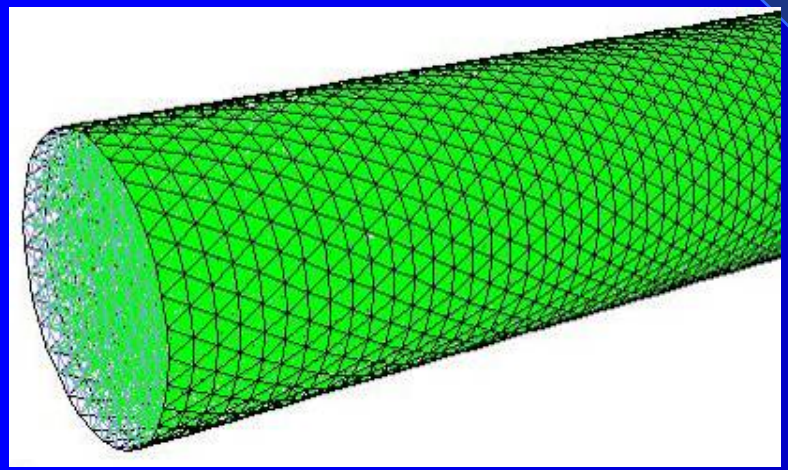
Proximate analysis		
Moisture	%	1.23 %
Ash	%	21.27 %
Volatiles	%	26.27 %
Fixed carbon	%	51.23 %
Other parameters		
Particles temperature	°C	20
Mass flow of particles	$g.s^{-1}$	5,56E-03
Rosin-Rammler index	N 1,26 x 39,87 µm	

Results obtained from experiments



Model in program Fluent





Devolatilization

$T_p \geq T_{vap}$ $\quad m_p \rangle (1 - f_{v,0})(1 - f_{w,0}) m_{p,0}$

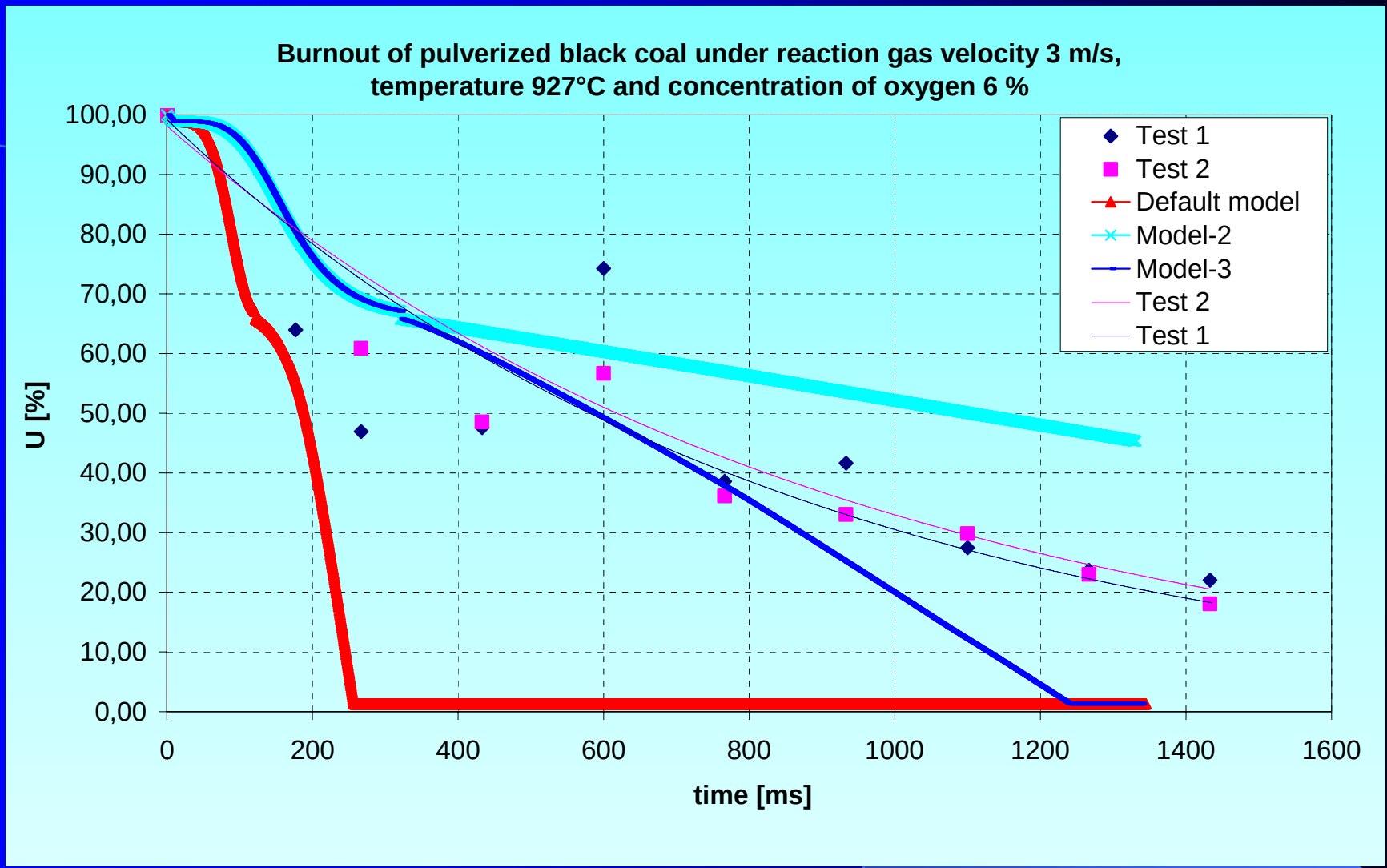
The single kinetic rate model

$$-\frac{dm_p}{dt} = k\left[m_p - (1 - f_{v,0})(1 - f_{w,0}) m_{p,0}\right]$$

Char combustion

$$m_p \rangle (1 - f_{v,0} - f_{comb})(1 - f_{w,0}) m_{p,0}$$

Modelling of experimental results in Fluent



Kinetic constants obtained from model

	Default model	Model 2	Model 3	Model 4
A (1)	312 000	312 00	312 00	?
E1 (J/Kmol)	7.4 e+07	7.4 e+07	7.4 e+07	?
C1 (1)	5,00E-12	5,00E-12	5,00E-12	?
C2 (1)	0.002	0.0002	0.00045	?
E2 (J/Kmol)	7.9e+07	7.9e+07	7.9e+07	?

Thank You for attention