LOWER AND UPPER EXPLOSION LIMITS FOR PULVERISED COAL

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INTRODUCTION

The associated theoretical-experimental method leads up to full information on the given coal and the given drying-grinding system which allow qualification of explosion limit with accuracy sufficient to anticipate the risk of explosion lying in features of coal, as well as in parameters of the processing, and in construction of the drying-grinding unit. This method comprises preliminary investigation of coal characteristics: elemental and industrial product analysis, examination of volatile particles, other physical-chemical tests, examination of porosity and granulation, etc.

Investigation of coal explosively by means of Hartman bomb with application of specially prepared representative samples is also included in this method. Theoretical analyses of heat balances of the investigated units and heat balances of the explosions of the given coal dust according to different process parameters to be applied to the given coal and the given drying-heating unit will be based on the results obtained from the above mentioned experiments.

The results of the investigations will be applied to qualify the safety operation range for existing and designed drying-grinding units.

The above mentioned investigation method will also be used for grading of the examined coal into three grades of explosivity. Explosivity grading is based on new checkable explosivity parameters comprising properties of coal expressly indicating explosive tendencies of the given coal formulated as specific parameters [ρ, LEP, UEP] to substitute general parameters such as volatile content, porosity, temperature of incandescence, flash-point temperature, etc. which allowed only to find out only generally understood explosive tendencies. The associated new method, however, provides detailed specific results with reference to the applied drying-grinding system.

ASSUMPTIONS OF THE METHOD

- the oxygen for the reaction with the coal coming only from the nearest space neighbourhood of the coal grain,
- the combustion is only kinetics, grain and combustion products heave the same temperature,
- no diffusion of the oxygen from other spaces of environment,
- the experimental determination of the LEL is possible only at a low concentration of coal in the coal/air mixture,
- initiation of explosion in a drying and grinding installation results from extending of ignition temperature,

Temperature at that concentration of coal will extend to other areas when the temperature of the explosion products, including ash and unburned coal particles, will be higher than of the ignition temperature of the dust cloud.

Practically the method consists:

- determination of LEL for the using coal in the Hartmann-bomb ,
- determination of penetrating depth of explosion into the coal grain for a monosizing trial as a relation of the burn-up mass of coal to the specific surface of the trial,
- on the basis of this value is possible to draft a heat balance of the coal/air - mixture and the adiabatic temperature of explosion t_w in dependence of the coal concentration K_W,
- the crossing points of both functions
- $t_z = f(K_W)$ and $t_w = f(K_W)$ establish the low explosion limit LEL and upper explosion limit UEL (Fig.1). [1]

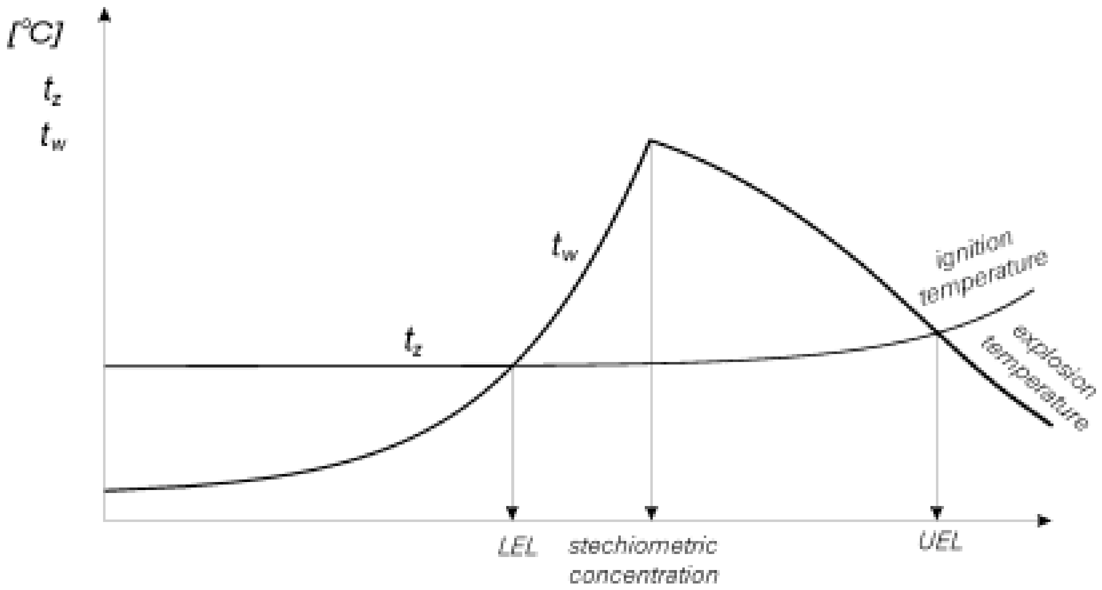

Fig 1. Distribution of temperature of explosion (t_w) and ignition (t_z) as a function of dust concentration

RESULTS

The following kinds of coal have been taken into consideration for investigating of explosion limits:
Group I - high calorific value coal (wk), 5% ash, 5% moisture, HHV about 30000 kJ/kg,
Group II - low calorific heat value coal (nk), 20% ash, and 10% moisture, HHV about 20000 kJ/kg
Ignition temperature as a function of coal concentration was statistically derived from other [2] data and taken as $t_z = 600 + 100K_W$.
It can be noticed in Fig 2. that the ignition temperature of coal dust cloud at low concentration takes place at about 600°C, at average concentration at about 650°C.
At the highest concentration (above 1000 g/m^3) the ignition temperature grows to above 700°C.
The investigation results of the upper explosion limits are shown in Fig. 3.

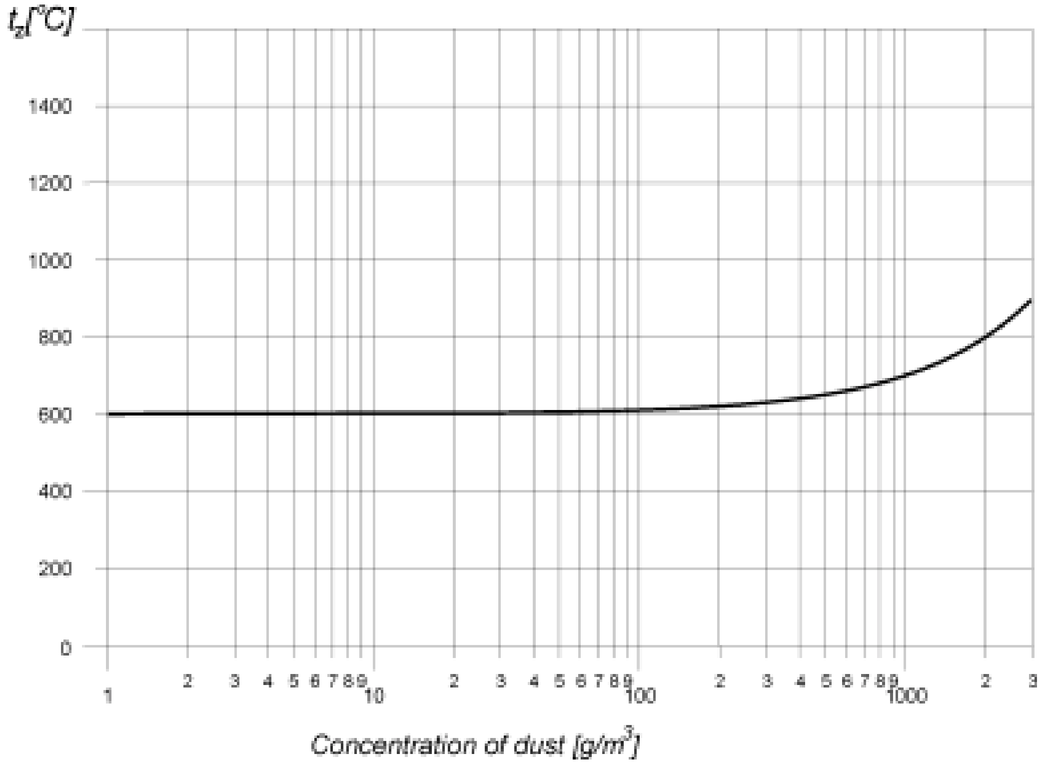

Fig 2. Temperature of ignition (t_z) as a function of dust concentration

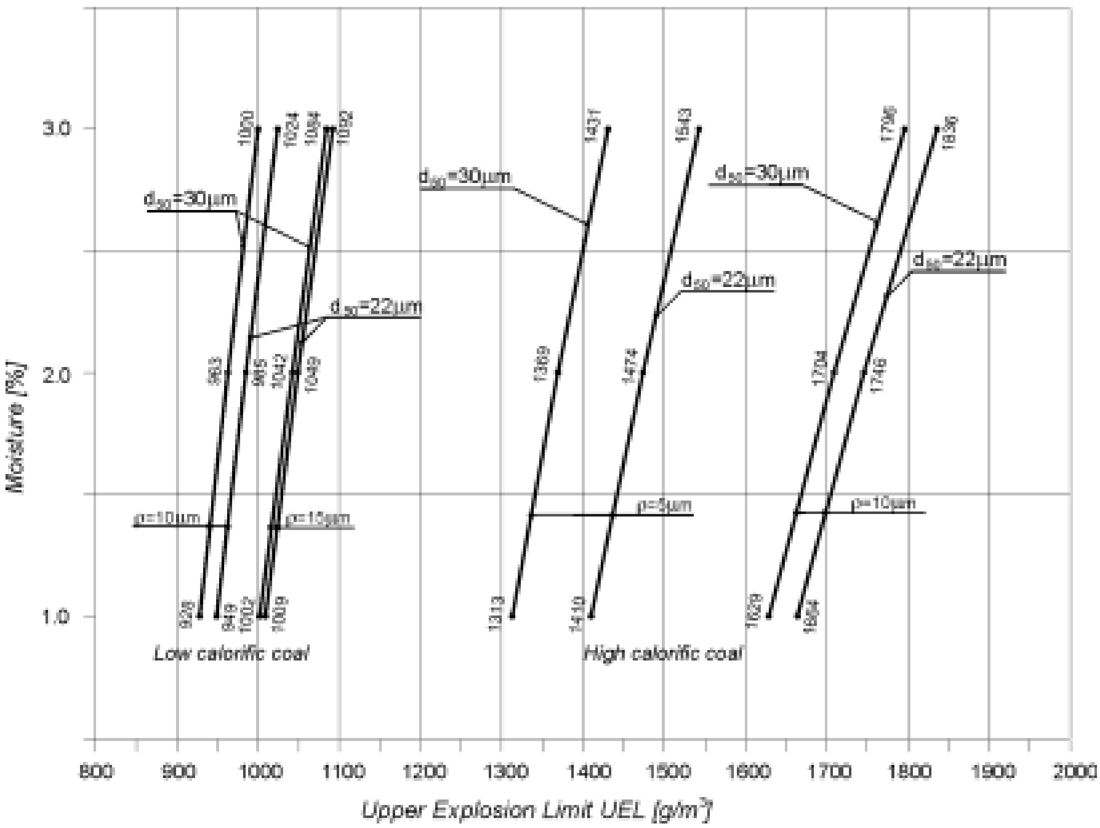

Fig. 3. Upper explosion limit for low and high calorific value coal,
d - diameter of coal particles, ρ - penetration depth.

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