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THE ANALYSIS OF INFLUENCING FACTORS ON COMBUSTION TIME OF THE LIGNITE IN TC KOSOVA A IN OBILIQ

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Abstract: *The combustion process depends in a rank of parameters of combustibles and generator. In determining the combustion process duration of the coal makes possible to determine approximately the position in which combustion process ends in the generator. Based on the chemical-physical and granule-metric analysis , in this research will be analyzed the impact of the half diameter of lignite particle r, air λ surplus, temperature in the combustion chamber T and gaseous components* v_{pls} *in the combustion time τ. The analysis performed helps in the definition of development combustion area, thermal loads in the generator as well as other technological and economic indicators important for optimal performance of caldron.*

Key words: *Boilers, lignite, particles, combustion, time.*

1. INTRODUCTION

Combustion time of lignite is an important factor of the combustion process in the generator. Combustion time can be calculated according to different authors such: Gumz, Nusselt, Mache, Traustel, Knore, (Kreuh, 1978) etc. In general, among the main parameters affecting in the combustion time of lignite particles τ those are half diameter of lignite particle r, air surplus λ, temperature in the combustion chamber T and gaseous components v_{pls}, (Knorre, 1966). For analysing the impact of these parameters in the combustion time of lignite particles, the need for recognition of the physical and chemical peculiarity of lignite (Lienhard, 2005) arises respectively lignite composition with components *mC, mH, mO, mS, mn, mv,* and *ma*, and granule-metric analysis of coal powder (Table 1).

i	0	1	2	3	4	5	6	7	8
d	50	50	63	71	80	80	200	500	1000
R	16.9	8.7	12	9.8	13.3	20.2	12.2	3.8	1.7

Tab. 1. Granule-metric analyze of lignite

For modelling of the task assigned, must be relying in basic modelling knowledge. The goal assigned within this model must be in such a form that in accurate manner shall reproduce the reality as whole complexity but with approximate and correct approach (McCabe, 2005).

2. THE COMBUSTION TIME OF LIGNITE AND AFFECTING FACTORS

The lignite combustion time depending of lignite transformation can be determined by Gumz with the following equation:

$$\tau = 1724\cdot 10^{6}\,\frac{\rho_{ko}\upsilon^{0.15} r^{1.85}}{T\,w^{0.15}}\,f_{\lambda}\left(1-\frac{v_{pls}}{100}\right)\frac{1}{\left(1-x/\lambda\right)}\,\xi^{-0.383} f_{\xi w} \qquad (1)$$

Where are:
ρ_{ko} - Combustion density in the initial state of the combustion process, kg/m3.
υ – Kinematics viscosity of combustion products (smoke), m^2/s.
r – Particles radial of combustibles,
w – Speed floating of the combustible particles, m/s.
$f\lambda$ – The dependent factor on air surplus.
v_{pls} - Gaseous ingredients of combustibles, %.
x - Part of oxygen used by the gaseous components, m_n^3/m_n^3.
ξ - Particles volume change factor of the combustibles during combustion: when the particles does not change ξ>1; during the volume growth ξ=1, during the reduction of volume ξ<1.
$f_{\xi w}$ - Factor which affects in the speed of floating during the change of particles volume.

Minimum amount of oxygen needed for combustion of *1 kg* of combustibles is determined by equation (Djuric, 1980):

$$v_{O\min} = 1.864mC + 5.55\left[mH - \left(mO/8\right)\right] + 0.698mS \qquad (2)$$

Minimum amount of air needed for combustion of *1 kg* of combustibles is determined by equation:

$$v_{L\min} = v_{O\min}/0.21 \qquad (3)$$

The amount of combustion products from 1kg of combustibles with air surplus coefficient determined by equation:

$$v_{pl\lambda} = 1.853mC + 0.7mS + 0.8mN + 0.79v_{l\min} + 1.24\left(9mH + mV\right) + \left(\lambda-1\right)v_{L\min} \qquad (4)$$

Real combustibles density in kg/m^3 determined by equation:

$$\rho_k = \left[1 - \left(v_{pls}/100\right)\right]\rho_{ko} \qquad (5)$$

Real combustibles density in kg/m^3 determined by equation:

The equation for determining the combustion time for $N_{Re}<100$ seconds according to:

$$\tau = \frac{35.6\cdot 10^{6} r_o^2 \rho_k}{2T\left[0.21\varphi + \frac{\left(\lambda-1\right)v_{L\min}\,0.21}{v_{pl\lambda}}\right]\xi_d} \qquad (6)$$

φ – Concentration factor
ξ_d –Diffusion factor of CO_2 (value based on experience).

3. CALCULATIONS AND OUTCOMES

The model of analysis impact for air surplus coefficient in the combustion time requires the data input as following: T=1000 °C; ρ_{ko}=900 kg/m^3; λ=1.3; v_{pls}=24.5; ξ=0.9; $w_s^{0.15}$= 0.820; f_λ= 0.568 për λ=1.30; x=0.26; ν=0.000045 m^2/s për T= 1000 °C; $V^{0.15}$=0.222834; ξ_d=0.6; φ=0.85; mC=25.24%;

mH= 1.99%; mO=2.78%; mS=0.14%; mn=9.31%; mv=43.65%; ma= 16.89%. In the model, the air surplus λ coefficient vary to the value1.1 up to value 1.5 (λ=1.10; λ=1.15; λ=1.20; λ=1.25; λ=1.30; λ=1.35; λ=1.40; λ=1.45; λ=1.50). Respective values of dependent factor on the air surplus fλ are: f_λ=0.773; f_λ=0.710; f_λ= 0.647; f_λ=0.608; f_λ=0.568; f_λ=0.541; f_λ= 0.513; f_λ=0.492; f_λ= 0.471.The radius particle values of lignite in calculate varying from r=0 till r=0.0004 mm., The temperature values varying from T=900 till T=1300 ^{o}C Whereas those of gaseous components v_{pls}=10% till v_{pls}=50%.

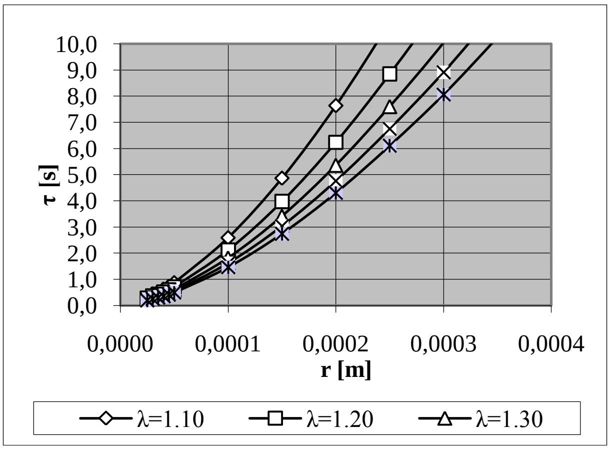

Fig. 1. Influence of λ in combustion time τ according to the Eq.(1)

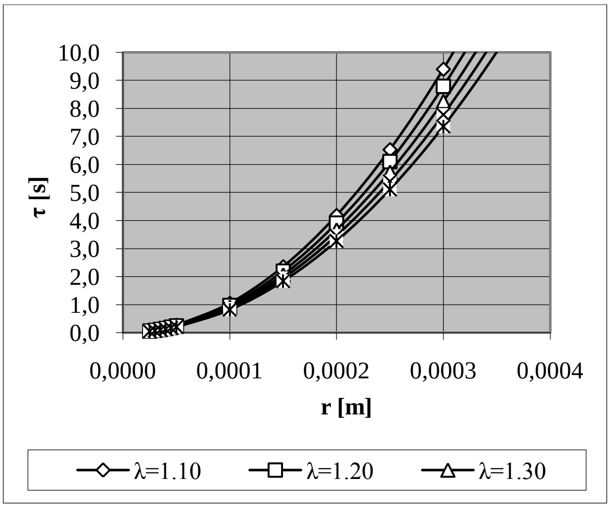

Fig. 2. Influence of λ in combustion time τ according to the Eq.(6)

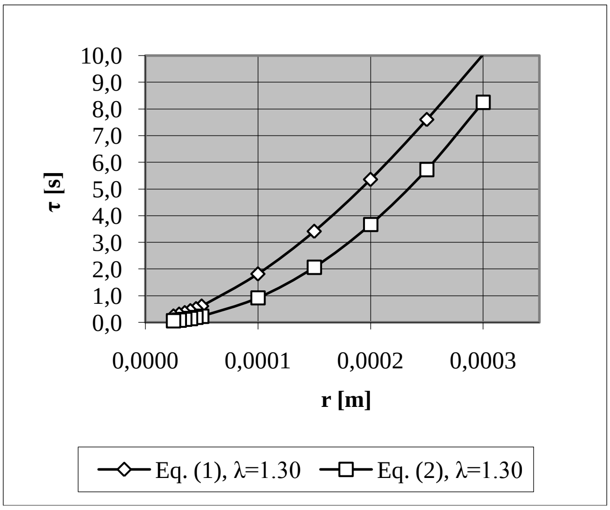

Fig. 3. Combustion time τ according to the Eq. (1) and Eq.(6)

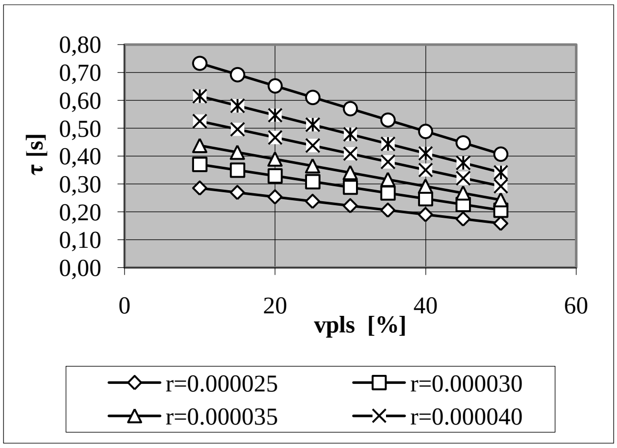

Fig. 4. Influence of v_{pls} in combustion time τ according to the Eq. (1)

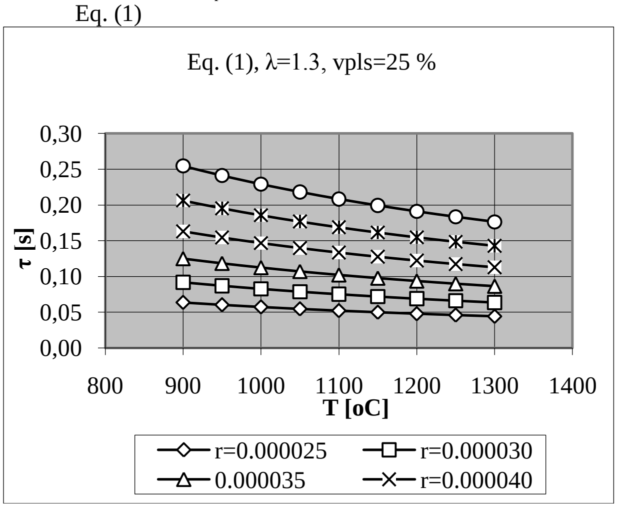

Fig. 5. Influence of T in combustion time τ according to the Eq.(6)

4. CONCLUSION

From the results obtained for the time of combustion according to equation (1) shows that the lignite particles size directly affects in combustion time according to the function $r^{1.85}$.

Results obtained by equation (6) shows that the time τ increases according to exponential square of half diameter of lignite particles r. Therefore, the combustion time is shorter for small diameters of lignite particles r, for higher temperatures in the combustion chamber T, for smaller air surplus λ. and the majority part of the gaseous components v_{pls}.

Comparative results of the curves according to equation (1) and (6) as shown in fig. 4, indicates a not great relative difference, of the combustion time. After determining the length of the combustion process of powdered coal particles can be determined the amount of combustibles that take part in combustion process depending on the position of particles but also the position of the end of the combustion process of particles depending of their diameter.

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