CI&CEQ

Available on line at
Association of the Chemical Engineers AChE
www.ache.org.rs/CICEQ

Chemical Industry & Chemical Engineering Quarterly 16 (3) 229–236 (2010) CI&CEQ

SLAVKO ĐURIĆ[1]
PETKO STANOJEVIĆ[2]
DAMIR ĐAKOVIĆ[3]
ALEKSANDAR JOVOVIĆ[4]

[1]Department of Environmental Engineering, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia
[2]Railways of the Republic of Srpska, Doboj, Bosnia and Herzegovina
[3]Department of Energy and Process Engineering, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia
[4]Department of Process Engineering, Mechanical Engineering Faculty, University of Belgrade, Belgrade, Serbia

SCIENTIFIC PAPER

UDC 662.613.1(497.15 Gacko)

DOI 10.2298/CICEQ091026016D

THE STUDY ON THE EFFECT OF FRACTIONAL COMPOSITION AND ASH PARTICLE DIAMETER ON THE ASH COLLECTION EFFICIENCY AT THE ELECTROSTATIC PRECIPITATOR*

The goal of experimental investigations shown in this paper is to estimate the operating efficiency degree of the electrostatic precipitator on a real industrial plant (a the thermal power plant „Gacko“ with the electric power of 310 MW, Bosnia & Herzegovina) and to use the obtained results as a base of periodical engineering or continual measurement and compare them with the investigations of other investigators. The investigation of the electrostatic precipitator performance was done according to BAS ISO 9096:2003. In this paper, the electrostatic precipitator efficiency during the ash particle removal with a wide range of particle sizes from 1 to 250 μm is evaluated. The exploitational experience points out that electrostatic precipitators are efficient for the coals of different quality (coal particles with diameters bigger than 1 μm) and that they could be optimized during the exploitation itself and for some following processes (e.g., flue gas desulphurization). Within the measurement plane, the measurements were made on 20 points per section. It has been noticed that ash removal degrees obtained experimentally (3 investigations) have approximately equal value (95.93 to 97.78%). The best concordance with the results of experimental investigation shows the Deutsch equation, while theoretical models of Zhibin-Guoquan and Nobrega-Falaguasta-Coury do not correspond well to the results of experimental investigations. For the ash particles with the diameters less than 17.5 μm there is no good correlation between investigated theoretical models. The highest deviation of the model for ash particles with diameters less than 17.5 μm is notable in the case of using the Deutsch equation.

Key words: electrostatic precipitator; collection efficiency; ash particles dimensions; velocity of flue gas; migration velocity of ash particle.

The electrostatic removal of solid particles from flue gases has a wide application in the range of the industrial processes. The electrostatic removal of solid particles from flue gases operating is based on the principle that the gas is allowed to pass between two electrodes one of which is grounded (plate collecting electrode), and the other which is connected to the negative pole of high-voltage current (coronary electrode). The particles in the gas stream are electrically charged and separated from the flue gas under the influence of electric field.

Flue gas process parameters (volume flow, temperature, velocity) and the parameters of the electrostatic precipitator (the length of the electric field, migration velocity of the ash particle, particle size distribution and the distance between plate collecting electrodes) have a big influence on the collection efficiency in an electrostatic precipitator.

Many researchers [1-7] analyze the influence of these parameters on the particle collection efficiency in the electrostatic precipitators and often give contradictory conclusions. Different mathematical models were used in order to show that geometric characteristics of the electrostatic precipitators (length of collecting electrodes, the distance between collecting electrodes, migration velocity) have influence on their collection efficiency.

Correspondening author: D. Đaković, Department of Energy and Process Engineering, Faculty of Technical Sciences, University of Novi Sad, Trg Dositeja Obradovića 6, Novi Sad, Serbia.
E-mail: djakovic@uns.ac.rs
*Part of this paper was presented at the Scientific Meeting Particulate Matter: Research and Management, 2nd Webiopatr Workshop, Mokra Gora, Serbia, 31 August-2 September, 2009.
Paper received: 26 October, 2009
Paper revised: 5 March, 2010
Paper accepted: 9 March, 2010

The paper [5] demonstrates a comparison between the results obtained by using theoretical models of Deutsch and Zhibin-Guoquan with the results of experimental examinations of the electrostatic precipitator in laboratory controlled conditions. The results obtained using the model of Deutsch and Zhibin-Guoquan do not correspond well with the experimental results of the particles with diameter less than 10 μm.

The newest model described in the paper [5] is a good approximation of the experimentally obtained results even for the particles with the diameter less than 10 μm.

The main goal of this paper is to compare the results obtained from the measurements of the ash particle collection in an electrostatic precipitator of a real industrial plant at the thermal power plant „Gacko" 310 MW, Bosnia and Herzegovina, with the results of the ash collection obtained by the available theoretical models.

A classic model of the ash collection in the electrostatic precipitator known as the equation of Deutsch, Eq. (1), is still used in engineering calculations [8]:

$$\eta = 100(1-e^{-\frac{A\omega}{Q}}) = 100(1-e^{-\frac{L\omega}{vs}}) \quad (1)$$

where: η - grade efficiency of the electrostatic precipitator (%), A - total area of collecting electrodes (m^2), ω - theoretical migration velocity of the ash particle (m/s), Q - flue gas volumetric flow rate through the electrostatic precipitator (m^3/s), L - length of the collecting electrodes (length of the electric field) (m), v - -velocity of the flue gas flowing through electrostatic precipitator (m/s) and s - distance between the discharge and collecting electrodes (m).

While designing the electrostatic precipitators, modified Deutsch equations are frequently used together with the Deutsch equation, Eq. (1) [9,10].

For ash particles with diameters less than 1 μm, theoretical migrational ash velocity could be calculated by using the following equation (Stokes-Cunningham) [8]:

$$\omega = \frac{qE}{3\pi\mu d_p}\left(1 + A^* \frac{2\lambda}{d_p}\right) \quad (2)$$

where: q - electrical saturation ash particles charge (C), E - electric field strength (V/m), μ - flue gas dynamic viscosity (Pa s), d_p - ash particle diameter (m), A^* - nondimensional parameter (its value for air is 0.86) and λ - mean free path of the molecules of the ambient gas (m).

During the practical engineering calculations for bigger ash particles (bigger than 1 μm) and where the dominating field is charging, migrational ash velocity could be determined by the following equation [11]:

$$\omega = 0.345\frac{\varepsilon_0 E^2 d_p}{\mu} \quad (3)$$

where: ε_0 - permittivity of the vacuum, 8.85×10^{-12} F/m, and 0.345 is correction factor.

The Deutsch equation assumes a constant concentration profile of solid particles collection. Zhibin and Guoquan [12] demonstrated the effect of diffusion included in the development of their analytical model of solid particles collected in an electrostatic precipitator. They suggested a theoretical equation in order to define the precipitator efficiency, e.g. the level of the solid particles efficiency:

$$\eta = 1-\left(\frac{Pe}{4\pi De}\right)^{0.5}\int_0^1 e^{-\frac{Pe(\xi-De)^2}{4De}}\,\mathrm{d}\xi \quad (4)$$

where: $Pe = \omega s/D_p$ is Peclet number, De = $\omega L/vs$ is Deutsch number, $D_p = 2\times10^{-7}/d_p$ is particle diffusivity (m^2/s) and ξ is traverse distance.

In newer investigations [5], the authors assumed that the concentration of solid particles increased towards the plate collecting electrodes and they suggested a new equation for the collection efficiency of solid particles in the electrostatic precipitator:

$$\eta = 1-\frac{\sqrt{\frac{Pe}{\pi}}}{De^{1.5}}\int_0^1 \xi e^{-\frac{Pe}{4De}(\xi-De)^2}\,\mathrm{d}\xi \quad (5)$$

EXPERIMENTAL INVESTIGATIONS OF THE SOLID PARTICLES EFFICIENCY IN THE ELECTROSTATIC PRECIPITATOR

The experimental investigation of the electrostatic precipitator and ash collecting in the electrostatic precipitator is performed at the thermal power plant „Gacko", Bosnia and Herzegovina, with the electric power of 310 MW. The examination of the electrostatic precipitator operation is performed according to the Regulation on emission limiting values into the air from the combustion plant (Official Gazette of the RS, No. 39/05) and according to standard methods of BAS ISO 9096:2003 [13].

The thermal power plant has one chimney which is 160 m high and 8.4 m in diameter. Its furnace temperature is in the range from 1250 to 1320 °C. At the furnace entrance, the excess air coefficient is in the range from 1.06 to 1.18, and at the furnace exit it is in the range from 1.35 to 1.40. The exit velocity of flue gases from the chimney is 11 m/s, with the temperature of 170 °C. The mass fraction of sulphur in lignite is about 1.33%. For combustion, the thermal power plant uses available coal with the quantity of about 300000 kg/h. The thermal power plant has two chimney channels, both with an electrostatic precipitator. More detailed characteristics of the plant and electrostatic precipitators are shown in the technical report [14].

Basic characteristics of the electrostatic precipitator are:

- Collecting electrodes the height of which is 12 m.

- The electric field length (collecting electrodes length) is made of four old fields (zones), 4×2.5 = 10 m, long and the fifth field, additionally made, 4 m long.

- Collecting electrodes distance in all fields is $2s$ = = 0.30 m.

- In the direction of the flow, flue gas is going through 49 passages (the width of the passage is the distance between collecting electrodes, $2s$), Figure 1.

The methodology of the ash concentration calculation in a flue gas (in front of and behind the electrostatic precipitator, points A and B, Figure 1) is gravimetric with weighing of the metal capsule (model Adventure, 65 g/0.1 mg) before and after the measurement on analytical scales. At three samples of ash particles (examinations 1-3) the distribution of ash particles dimensions is determined at the sieves Coulter Counter with the calibre up to 37 μm. About 65% of ash particles have the diameter bigger than 17.5 μm. The examinations have also shown a much bigger mass fraction of ash particles with the diameter bigger than 125 μm for examination 3 than for examinations 1 and 2 (Table 1 and Figure 2). This could be explained by the voltage change in the electrostatic precipitator during the examination from average 35 kV, for examinations 1 and 2, to 52 kV for examination 3.

During the process in a measurement plane (measured at 20 points by a section), gaseous pollutants concentrations in flue gases (O_2, CO_2, CO, NO_2, SO_2), and in the second process physical characteristics of the flue gas (flow, temperature, velocity) behind the electrostatic precipitator were measured (point B, Figure 1). Other measured parameters are shown in [14]. According to measured values of the specified parameters, recalculations to normed conditions (0 °C and 101.3 kPa) were performed. The measured concentrations of polluting substances in the flue gas were reduced to the appropriate fraction of O_2 of 6% (Table 2).

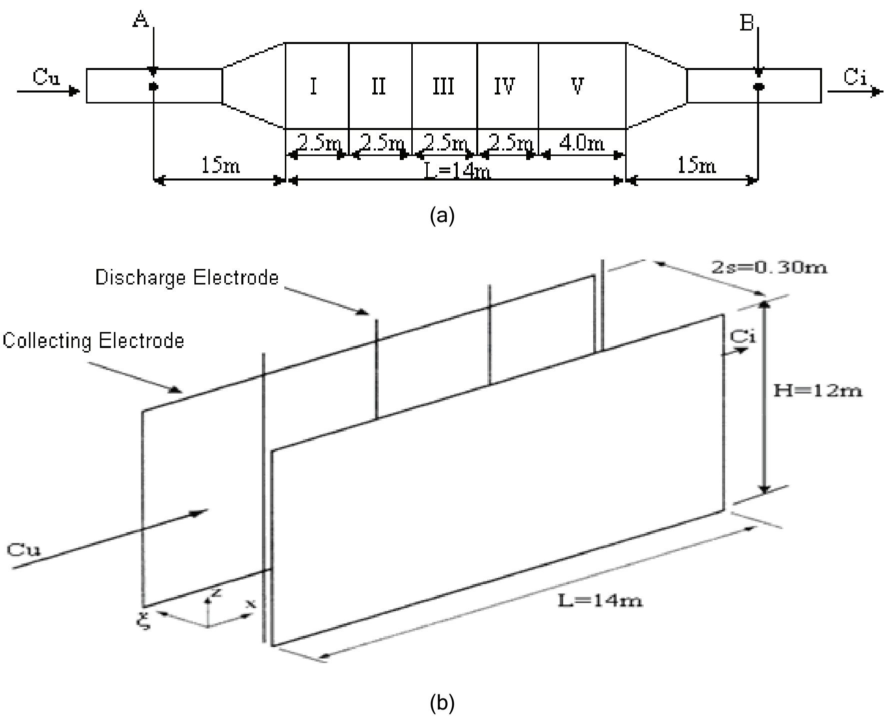

Figure 1. a) A schematic diagram of the electrostatic precipitator with ash particles and polluting substances in flue gas sampling positions, b) a schematic diagram of collecting and discharge electrodes of electrostatic precipitator (C_u- mass ash particle concentration at the entrance (mg/N m^3), C_i - mass ash particle concentration at the exit (mg/N m^3), H - height of collecting electrodes (m), L - length of collecting electrodes (m), 2s - distance between collecting electrodes, I-V - electric fields (zones), A,B - positions of ash particles sampling).

Table 1. The ash granulometry composition in the thermal power plant "Gacko" [14]

d_p / µm	$<d_p>$ / µm	Examination 1		Examination 2		Examination 3	
		Mass ratio of fractions, %	Cumulative ratio mass fraction, %	Mass ratio of fractions, %	Cumulative ratio mass fraction, %	Mass ratio of fractions, %	Cumulative ratio mass fraction, %
>250	250	0.54	100.00	0.72	100.00	2.03	100.00
125-250	187.5	4.49	99.46	6.12	99.28	11.43	97.97
80-125	102.5	14.27	94.97	14.46	93.16	16.92	86.54
37-80	58.5	11.73	80.70	16.44	78.70	15.69	69.62
30-37	33.5	11.72	68.97	6.04	62.26	4.42	53.93
20-30	25.0	22.28	57.25	17.06	56.22	15.86	49.51
15-20	17.5	12.21	34.97	14.44	39.16	11.38	33.65
10-15	12.5	10.90	22.76	14.82	24.72	10.62	22.27
8-10	9.0	4.07	11.86	4.20	9.90	3.94	11.65
1-8	4.5	7.79	7.79	5.70	5.70	7.71	7.71
Entrance		100.00		100.00		100.00	

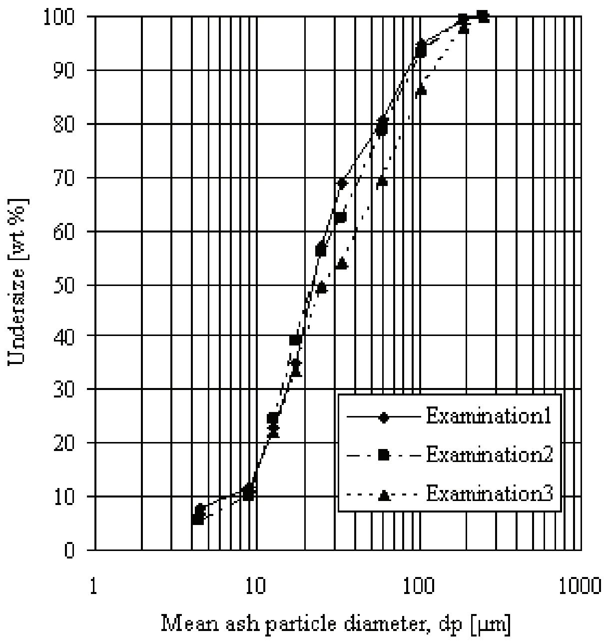

Figure 2. The fly ash size distribution in the thermal power plant "Gacko".

Dry gases were brought by a pipe to the gas entrance to the analyser Dräger MSI 150 PRO 2, which was used for direct measurement of pollutant substances with an error less than 5%. The device was connected to PC by the RS 232 cable and the performing processing of the measurement results was done during sonda reading every two minutes by using DERAS software. A detailed description of the material and equipment used during the examination of the electrostatic precipitator operation is shown in the technical report [14].

The ash (solid particles) collection efficiency in the electrostatic precipitator is determined using the following equation:

$$\eta = 100\left(1-\frac{C_i}{C_u}\right) \tag{6}$$

where: η is grade efficiency of the electrostatic precipitator (%), C_u is mass volume ash concentration at the entrance of electrostatic precipitator and C_i is mass volume ash concentration at the exit of electrostatic precipitator (mg/N m^3).

Dynamic viscosity of the flue gas is determined using the following equation [15]:

$$\mu = \sum_{i=1}^{n} \frac{\mu_i}{1+\sum\limits_{\substack{j=1\\ j\neq i}}^{n} \Phi_{ij}\frac{\varphi_j}{\varphi_i}} \tag{7}$$

where Φ_{ij} is a function which can be calculated using Bromley and Wilke's method of approach:

$$\Phi_{ij} = \frac{\left[1+\sqrt{\frac{\mu_i}{\mu_j}}\left(\frac{M_j}{M_i}\right)^{\frac{1}{4}}\right]^2}{\sqrt{8\left(1+\frac{M_i}{M_j}\right)}} \tag{8}$$

where: μ_i and μ_j - dynamic viscosities of the components „*i*" and „*j*" (Pa s), φ_i and φ_j - volume fractions of the components „*i*" and „*j*" in the mixture and M_i and M_j - molar masses of the components „*i*" and „*j*" (g/mol).

To include the ash fractional composition during calculating the ash collecting efficiency level the following equation is used:

$$\eta = \sum_{i=1}^{n} \frac{\phi_i}{100} \eta_i \tag{9}$$

whereas: η - total degree of ash collection in the electrostatic precipitator [%], ϕ_i is mass ratio of fraction „i" (fractional composition) [%] and η_i - ash particles collection efficiency for the fraction „i" [%].

RESULTS AND DISCUSSION ON EXPERIMENTAL INVESTIGATIONS

Table 2 shows the results of experimental examinations (examinations 1-3) of ash particles efficiency in the electrostatic precipitator with collecting electrodes distance $2s$ = 0.30 m which operates with the same specific collecting area A/Q for given examination (for examination 1, A/Q = 86.2742 s/m, for examination 2, A/Q = 84.5512 s/m and for examination 3, A/Q = 84.7931 s/m). During teh examinations the strength of the electric field in the electrostatic precipitator varied and ranged from 117 to 172 kV/m. The ash collection degree has approximately the same value for each of the three examinations and it ranges from 95.93 to 97.78%. This could have been be expected considering the approximately same value of ratio A/Q and approximately the same value of migrational velocity of about 0.04 m/s.

Fractional composition of ash and ash particles diameter substantially influences the ash collection degree in the electrostatic precipitator. Ash particles the diameters of which are less than 17.5 μm, have a lower degree of ash collection and range from 68 to 99%. For ash particles with diameters bigger than 17.5 μm, the ash collection degree has approximately the same value for each of the three examinations and it ranges from 99 to 100% (Figure 3).

The comparison between theoretical models and experimental data on the ash particles collection efficiency

The ash collection efficiency in the electrostatic precipitator, estimated by the use of theoretical models of Deutsch (Eq. (1)), Zhibin-Guoquan (Eq. (4))

Table 2. Mean measured and calculated values needed for the electrostatic precipitator analysis in the thermal power plant "Gacko" [14]

Characteristic parameter	Examination		
	1	2	3
Coal consumption, m_C / kg h^{-1}	300000	300000	300000
Mass fraction of ash in coal, A_C / %	11.76	17.55	21.76
Volume fraction of wet in flue gas, W / %	17.2±0.5	16.8±0.5	16.9±0.5
Volume fraction of O_2 in flue gas, %	7.0±0.3	8.3±0.3	8.3±0.3
Volume fraction of CO_2 in flue gas, %	13.6±0.3	12.0±0.3	13.6±0.3
Volumetric flow rate of wet flue gas, Q_W / N m^3 h^{-1}	687000	701000	699000
Volumetric flow rate of dry flue gas, Q_D / N m^3 h^{-1}	568836	583232	580869
Flue gas temperature, t / °C	204±2	196±2	199±2
Mean velocity of flue gas through the electrostatic precipitator, v / m s^{-1}	1.1	1.1	1.1
Flue gas dynamic viscosity, μ / 10^{-6} Pa s	14.288	14.511	14.506
Mean electric field strength, E / kV m^{-1}	117	138	172
Collecting electrodes effective area, A / m^2	16464	16464	16464
Length of collecting electrodes, L / m	14	14	14
Height of collecting electrodes, H / m	12	12	12
Distance between collecting electrodes, $2s$ / m	0.30	0.30	0.30
Ash particle migration velocity, ω / m s^{-1}	0.0377	0.0449	0.0440
Specific collecting area, AQ^{-1} / s m^{-1}	86.2742	84.5512	84.7931
Mean value of ash particles collection in electrostatic precipitator (Eqs. (1) and (9)), η / %	96.43	97.91	99.22
Mean value of ash particles collection in electrostatic precipitator (Eqs. (4) and (9)), η / %	97.15	98.08	98.92
Mean values of ash particles collection in electrostatic precipitator Eqs. (5) and (9)), η / %	98.97	99.40	99.72
Ash volumetric mass concentration at electrostatic precipitator entrance, c_u (dry flue gas, 6% O_2) / mg N m^{-3}	29926	47928	59622
Ash volumetric mass concentration at electrostatic precipitator exit, c_i (dry flue gas, 6% O_2) / mg N m^{-3}	1218	1064	1419
Ash collecting efficiency in the electrostatic precipitator (Eq. (6)), η / %	95.93	97.78	97.62

and Nóbrega-Falaguasta-Coury (Eq. (5)), is shown in Figure 4.

As it can be noticed in Figure 4, the correlations of theoretical models (Eqs. (1), (4) and (5)) are in good accordance regarding the ash particles diameters bigger than 17.5 μm. As for the ash particles with diameters less than 17.5 μm, there is no good accordance between the investigated models. The biggest deviation between the models is noticed with the Deutsch equation, Eq. (1).

Figure 5 shows the comparison of values of mean ash particles collection efficiency with a wide

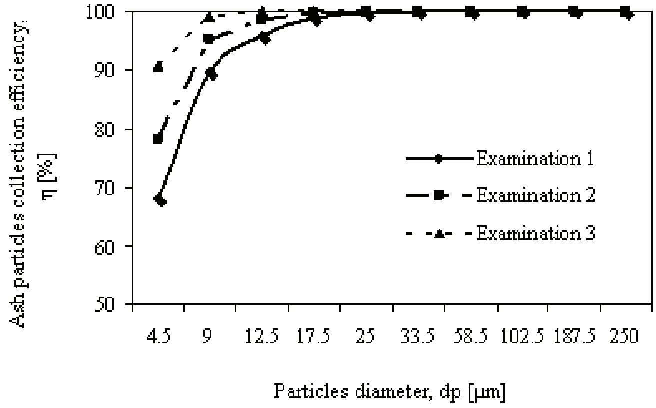

Figure 3. The influence of the ash particle diameter on the ash collection efficiency.

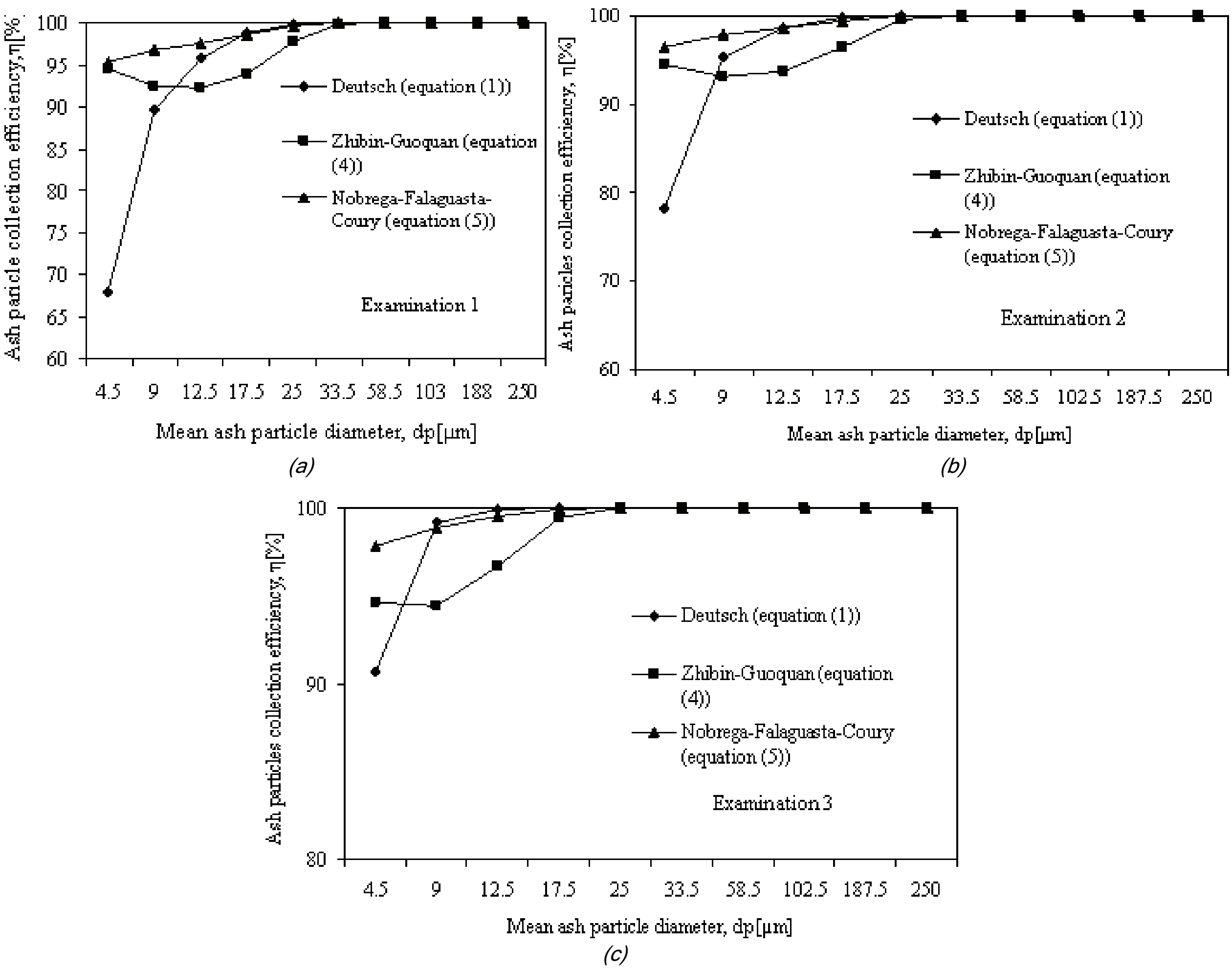

Figure 4. The ash collection efficiency comparison by using *different theoretical models in the electrostatic precipitator, examination: a) 1, b) 2 and c) 3.*

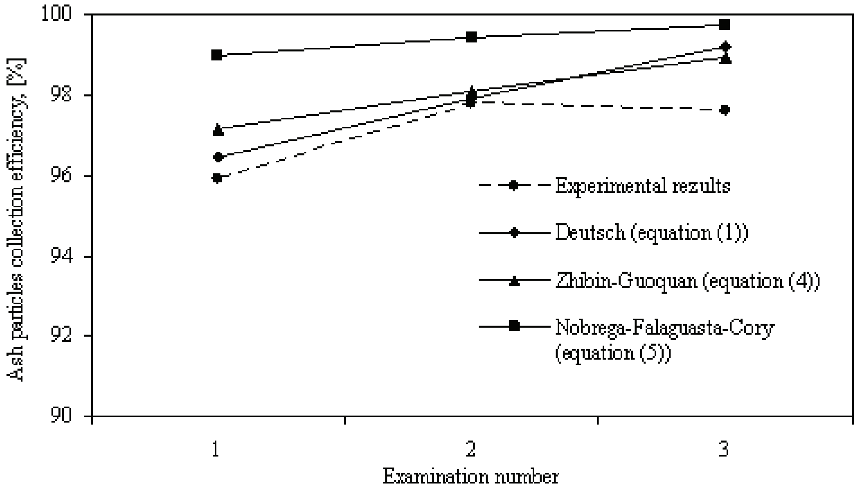

Figure 5. The comparison of the ash particle mean collection efficiencies in the electrostatic precipitator between theoretical models (Eqs. (1), (4) and (5)) and experimental results.

distribution of particle dimensions in the range from 1 to 250 μm in the electrostatic precipitator, calculated from the experiments with foreseeing theoretical models of Deutsch (Eq. (1)), Zhibin-Guoquan (Eq. (4)) and Nóbrega-Falaguasta-Coury (Eq. (5)). It is noticeable that Deutsch model (Eq. (1)) is the best approximation of the experimental examination of the ash particles collection efficiency in the electrostatic precipitator. Other theoretical models (Eqs. (4) and (5)) do not approximate the best results obtained through experimental examinations.

Comparing the experimental results and applied theoretical models (Figures 4 and 5) with the results of experimental examinations and applied theoretical models shown in [5] a relatively good accordance for the ash particles with diameters bigger than 17.5 μm can be noticed.

CONCLUSIONS

In this article the electrostatic precipitator efficiency during the ash particle removal with a wide range of particle sizes from 1 to 250 μm is evaluated.

Experimental investigations were performed in the real industrial plant (at the thermal power plant „Gacko“, Bosnia and Herzegovina, with the electric power of 310 MW). They indicate approximatelly equal value of the ash collecting degree for all three investigations. The values of the ash particles collection are in the range from 95.93 to 97.78%.

Theoretical models of Zhibin-Guoquan and Nóbrega-Falaguasta-Coury shown in this paper do not approximate best the results of experimental examinations executed in the industrial plant (thermal power plant „Gacko“).

The Deutsch equation shows the best concordance with the results of experimental examinations. This could have been expected, because about 65% of ash particles have a diameter bigger than 17.5 μm. For ash particles with diameters less than 17.5 μm, there is no good correlation between considered theoretical models. The biggest deviation was noticed by using the Deutsch equation and the smallest by using the Zhibin-Guoquan and Nóbrega-Falaguasta-Coury model. Considered models inconsistency could be explained by the complexity of the ash particles phenomenon in the electrostatic precipitator, with the particles of smaller diameter and especially diameters less than 1 μm, which was examined by Zhibin-Guoquan, Nóbrega-Falaguasta-Coury and other models [16-18].

Nomenclature

A_C - Ash mass fraction in coal, %
A - Total collecting area of plate collecting electrodes, m^2
A^* - Dimensionless parameter
c_i - Mass volume ash concentration at the exit of the electrostatic precipitator, mg/N m^3
c_u - Mass volume ash concentration at the entrance of the electrostatic precipitator, mg/N m^3
De - Deutsch number, dimensionless
d_p - Ash particle diameter, μm
D_p - Ash particle diffusivity, m^2/s
E - Electric field strength, V/m
H - Length of the collecting electrode, m
L - Length of the collecting electrode, m
M_i - Molar mass of component „i“ in flue gas, g/mol
m_C - Coal mass flow (coal consumption), kg/h
Pe - Peclet number, dimensionless
q - Saturation charging of ash particles, C
Q - Flue gas volumetric flow rate, N m^3/h

s - Distance between the discharge and the collecting electrodes, m
t - Flue gas temperature, °C
v - Flue gas velocity, m/s
ω - Ash particle migration velocity, m/s
φ_i - Volumetric fraction of component „i“ in flue gas, %
Φ_i - Fraction of ash particles with mean diameter d_{pi}, %
η_i - Grade efficiency of ash particles fractions Φ_i with mean diameter d_{pi}, %
ε_0 - Permitivity of the vacuum, F/m
η - Total grade efficiency of ash particles (ash particle collection efficiency), %
λ - Mean free path of flue gas molecules, m
μ - Flue gas viscosity, Pa s.

REFERENCES

[1] G. Leonard, M. Mitchner, S. A. Self, Atmos. Environ. **14** (1980) 1289-1299

[2] H. H. Petersen, IEEE T. Ind. Appl. **IA-17** (1981) 496-501

[3] C. Riehle, F. Löffler, J. Electrostat. **29** (1992) 147-165

[4] A. Zukeran, J.-S. Chang, A. A. Berezin, T. Ito, J. Aerosol Sci. **28** (1997) 289-290

[5] S. W. Nóbrega, M. C. R. Falaguasta, J. R. Coury, Braz. J. Chem. Eng. **21** (2004) 275-284

[6] G. Bacchiega, I. Gallimberti, E. Sani, R. Sala, V. Arrondel, M. Hamlil, E. Christensen, J. Electrostat. **64** (2006) 297-309

[7] H. Zhao, C. Zheng, Fuel **87** (2008) 2082-2089

[8] S. Calvert, H. Englubd, Handbook of Air Pollution Technology, John Wiley & Sons, New York, 1984

[9] S. Matts, P.Öhnfeld, Efficient gas cleaning with SF electrostatic precipitators, SF Rev. Vols. 6 and 7, 1964

[10] H.H. Petersen, A precipitator sizing formula. Proc. 4th Int. Conf. on Electrostatics Precipitation, Int. Academic Publisher, Beijing, China, 1990, pp. 330-338

[11] А. Г. Амелин, Производство серной кислоты, Химия, Москва, 1964

[12] Z. Zhibin, Z. Guoquan, Aerosol Sci. Tech. **20** (1994) 169--176

[13] BAS ISO 9096:2003 “Stationary source emissions - Manual determination of mass concentration of particulate matter“

[14] Đ. Čobanović, M. Đokić, A. Đerisilo, M. Gigov, M. Popović, Sampling, measurement and laboratory examination report on waste materia emissions into the air. Coal, slag and ash analysis, System Qualita, S, Pale - Institute of Mining , Zemun, Belgrade, Coal mining and Thermal Power Plant, Gacko, 2007 (In Serbian)

[15] L. A. Bromley, and C. R. Wilke, Ind. Eng. Chem. **43** (1951) 1641-1648

[16] Y. Zhuang, Y.J. Kim, T.G. Lee, P. Biswas, J. Electrostat. **48** (2000) 245-260

[17] J. H. Byeon, J. Hwang, J. H. Park, K. Y. Yoon, B. J. Ko, S. H. Kang, J. H. Ji, Aerosol Sci. **37** (2006) 1618-1628

[18] C. Riehle, F. Löffler, Aerosol Sci. Tech. **16** (1992) 1-14.

SLAVKO ĐURIĆ[1]
PETKO STANOJEVIĆ[2]
DAMIR ĐAKOVIĆ[3]
ALEKSANDAR JOVOVIĆ[4]

[1]Departman za inženjerstvo zaštite životne sredine, Fakultet tehničkih nauka, Univerzitet u Novom Sadu, Trg Dositeja Obradovića 6, Novi Sad, Srbija
[2]Železnice Republike Srpske, Doboj, Bosna i Hercegovina
[3]Departman za energetiku i procesnu tehniku, Fakultet tehničkih nauka, Univerzitet u Novom Sadu, Trg Dositeja Obradovića 6, Novi Sad, Srbija
[4]Departman za procesnu tehniku, Mašinski fakultet, Univerzitet u Beogradu, Kraljice Marije 16, Beograd, Srbija

NAUČNI RAD

PROUČAVANJE UTICAJA FRAKCIONOG SASTAVA I PREČNIKA ČESTICA PEPELA NA STEPEN IZDVAJANJA U ELEKTROSTATIČKOM FILTRU

Cilj eksperimentalnih istraživanja prikazanih u ovom radu jeste da se proceni stepen efikasnosti rada elektrostatičkog filtra na realnom industrijskom postrojenju (termoelektrana „Gacko“ električne snage od 310 MW, Bosna i Hercegovina) i dobijeni rezultati iskoriste za projektovanje periodičnog ili neprekidnog merenja i uporede sa rezultatima istraživanja drugih istraživača. Istraživanje performansi elektrostatičkog filtra je izvršeno u skladu sa BAS ISO 9096:2003. Efikasnost elektrostatičkog filtra je procenjena tokom uklanjanja čestica pepela u širokom opsegu veličina čestica od 1 do 250 μm. Eksploataciona iskustva ukazuju da su elektrostatički filtri efikasni za ugljeve različitog kvaliteta (prečnik čestica pepela veći od 1 μm) i da se mogu optimizovati, kako u toku samog rada, tako i za neke naredne procese, kao što je odsumporavanje dimnih gasova. U mernim ravnima, merenja su vršena na 20 tačaka po preseku. Primećeno je da stepen uklanjanja pepela dobijen eksperimentalno (3 ispitivanja) ima približno jednake vrednosti (95,93-97,78%). Najbolje slaganje sa rezultatima eksperimentalnih ispitivanja pokazuje jednačina Deutsch-a, dok teorijski modeli Zhibin-Guoquan i Nobrega-Falaguasta-Coury ne aproksimiraju najbolje rezultate eksperimentalnih ispitivanja. Za čestice pepela prečnika manjeg od 17,5 μm ne postoji dobra korelacija između ispitivanih teorijskih modela. Najveće odstupanje modela za čestice pepela prečnika manjih od 17,5 μm je primećeno u slučaju upotrebe jednačine Deutsch-a.

Ključne reči: elektrostatički filtar; stepen izdvajanja; dimenzije čestica pepela; brzina dimnog gasa; migraciona brzina čestica pepela.