Studies Regarding the Effect of Fly Ash used on Coagulation-settling Process of Water Suspensions

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Paper objectives aim to establish the effect of fly ash addition on coagulation process of water and wastewater suspensions and on some water parameters after settling. The fly ash addition has a positive effect on coagulation-settling process from the point of view of treated water turbidity, in the case of wastewaters as well as in the case of natural water. At small fly ash doses the positive effect on turbidity of treated water is increased. The fly ash addition has a negativ effect on residual aluminium concentration from treated water even at small fly ash doses in wastewater, as well as in natural water.

Keywords: coagulation, fly ash, turbidity, aluminium residual, Jar-test method

One of the main today subjects in the field are to develop new applications of fly ash, produced in growing quantities by burning coal in all coal-fired power stations and other industrial sources. Increasing concerns about the environmental consequences of such disposal have led to investigations into other possible utilizations [1].

The fly ash produced from the burning of pulverized coal in a coal-fired boiler is a fine-grained, powdery particulate material that is carried off in the flue gas and usually collected from the flue gas by means of electrostatic precipitators or mechanical collection devices such as cyclones [2 - 4].

Fly ash generally consists of fine spherical particles usually ranging in diameter from 0.5 to 100 μm. Fly ash particles are inhomogeneous. The color of fly ash spans the spectrum from light tan to gray black. The physical properties of fly ash depend on the type of equipment used for collecting fly ash. The chemical composition of fly ash is affected by the geological and geographical factors of the coal deposit, coal rank, boiler operation conditions, and fuel gas pollution control technology applied [5].

One of the most important steps in the process of water and wastewater treatment is coagulation for the removal of suspensions.

Colloidal species encountered in raw water and wastewater include clay, silica, iron and other heavy metals, color, and organic solids such as the debris of dead organisms. Colloids may also be produced in precipitation processes such as lime softening [6].

Coagulation is a complex process, involving many reactions and mass transfer steps. As practiced in water treatment the process is essentially three separate and sequential steps: coagulant formation, particle destabilization, and interparticle collisions [7, 8].

There are some difficulties to realize optimum conditions for coagulation due to the variability of water quality, like temperature, turbidity and organic matter content [9, 10].

The flexibility and efficiency of this operation may be influenced by fly ash addition in mixing step of coagulation process.

The aim of this paper was:

- to establish the influence of fly ash addition on coagulation process and on some water parameters after settling in the case of wastewater;
- to establish the influence of fly ash addition on coagulation process and on some water parameters after settling in the case of natural water.

Experimental part

Experiments regarding coagulation process were undertaken by use of Jar-test method, with a SBS instrument. Operating conditions were as follows: rapid mixing for 60 s (140 rot/min), slow mixing for 20 min (40 rot/min) and settling time 30 min [11 - 15].

Turbidity and residual aluminium were analized by use of Hanna LP 2000 turbidimeter and atomic absorbtion spectrophotometer SPECTRA AAS VARIAN with graphite furnance GTA 110.

Experiments were realized with water from two different sources: natural water from Bega River and syntetic wastewater. Waters parameters were turbidity T = 9.6 FTU, temperature t = 16°C for Bega River and turbidity T = 295.0 FTU, temperature t = 18°C for syntetic wastewater.

Aluminium sulphate was used as coagulant, technical product, solution with concentration of 10 g/L. *p*H values of water samples treated with coagulant ranged between 7.4 – 7.6, due to different doses of AS. Experimental conditions were closed to those used for water treatment facilities.

In all experiments fly ash from a coal power-station was used. Major constituents of fly ash are presented in table 1.

Results and discussions

Establishing the influence of fly ash addition on coagulation process and on some water parameters after settling in the case of wastewater

In figure 1 are presented the coagulation curves for wastewater at different fly ash doses added. The results from figure 1 show that the fly ash addition present a positive effect on coagulation- settling process.

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Table 1
MAJOR CONSTITUENTS OF FLY ASH

	Element concentrations as oxides, (%)				
	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO
Fly ash	46,2	23,2	8,1	8,6	3,5

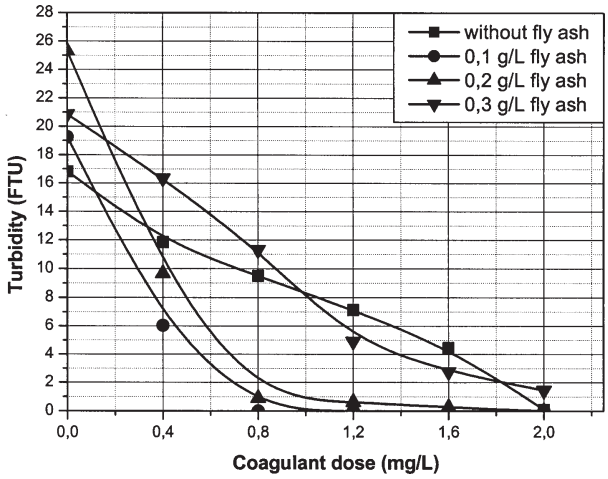

Fig. 1. Coagulation curves for wastewater suspension at different fly ash doses added

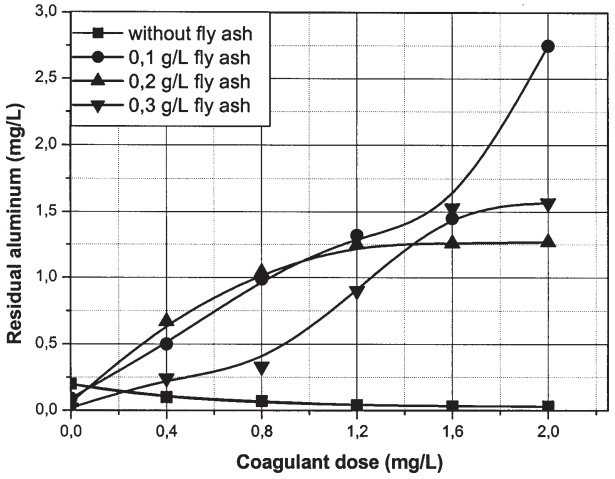

Fig. 2. Variation of residual aluminium concentration from treated wastewater at different added fly ash doses

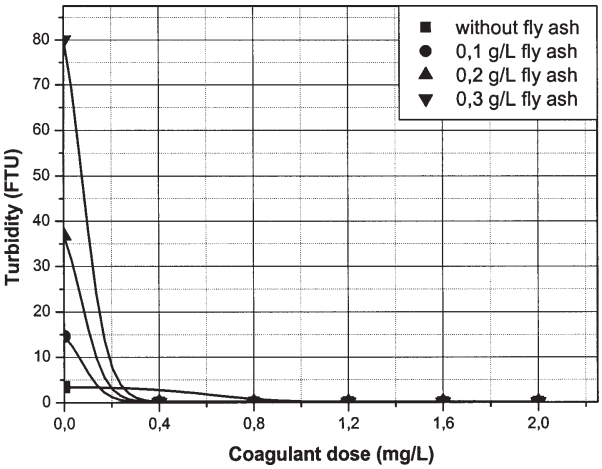

Fig. 3. Coagulation curves for natural water suspension at different fly ash doses added

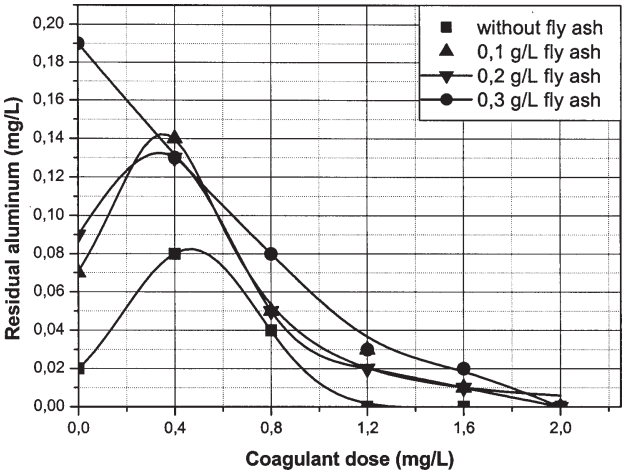

Fig. 4. Variation of residual aluminium concentration from treated natural water at different added fly ash doses

Although the turbidity at dose zero is higher in the case that it was used fly ash, the o turbidities at the same coagulant dose are smaller than in the case when this material was not used. At smaller fly ash doses the positive effect on turbidity of treated water is increased.

Figure 2 shows the variation of residual aluminium concentration from treated wastewater at different added fly ash doses.

In accordance with figure 2 the addition of fly ash has a negative effect on residual aluminium concentration from treated water even at small fly ash doses.

Establishing the influence of fly ash addition on coagulation process and on some water parameters after settling in the case of natural water

Figure 3 shows the coagulation curves of suspensions from a natural water at different fly ash doses added. It can be observed that the obtaining results are similar with the results obtained in the case of wastewater suspension coagulation. The fly ash addition has a positive effect, especially at small doses. This effect can be explained from the fact that the fly ash addition increase of the suspensions concentration, leads to the intensification of adsorption mechanism of coagulation process and also a ,,sweeper-effect'' appear that is shoving a part of water colloids [13 - 16].

The variation of residual aluminium concentration from natural water treated at different doses of fly ash added is presented in figure 4.

The obtained results are in this case, as previous, similar with the results obtained from a waste water. The fly ash adduct has an negativ effect on residual aluminium concentration from treated water even at small fly ash doses. This is due to the fact that the fly ash contains aluminium soluble compounds.

Conclusions

The fly ash addition has a positive effect on coagulation-settling process from the point of view of treated water turbidity, in the case of wastewaters as well as in the case of natural water.

Although the turbidity at dose zero is higher in the case it is used fly ash, the o turbidities at the same coagulant dose are smaller than in the case when this material was not used.

At small fly ash doses the positive effect on turbidity of treated water is increased. This effect can be explained

from the fact that the fly ash addition increase of the suspensions concentration, leads to the intensification of adsorption mechanism of coagulation process and also a ,,sweeper-effect'' appear that is shoving a part of water colloids.

The fly ash adduct has a negative effect on residual aluminium concentration from treated water even at small fly ash doses, in wastewater, as well as in natural water. This is due to the fact that the fly ash contains aluminium soluble compounds.

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