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Production of Concrete in Construction Engineering, Adding Grace from Power Plants

Lulëzim Bytyçi
Phdc, OLSKA ING, Prishtinë, Kosovë
info@olskaing.com

Fisnik Kadiu
Prof. Dr., Universiteti Politeknik, FIN, Tiranë

Musa Stavileci
Prof. Dr., Universiteti „Hasan Prishtina“, FNA, Prishtinë

ABSTRACT

In this paper we will talk about the production of concrete in construction engineering, adding grace from power plants. From burning coal in power plants in Kosovo is being produced a large amount of ashes, which results as technological waste. From the economic view, environmental and science, this study is undertaken in accordance with the requirements of European standard ENV 206-1 and EN450-1, EN450-2.

The main goal of this study is to use the power plant ashes as raw material for the production of concrete and to determine the optimal mixing ratios. Today there is a extensive experience in the use of thermal power plants ashes for concrete production, but to those that produced in Kosovo, this is the first study undertaken in this field.

With the use of thermal power plants ashes in concrete planned generation facility, we will try to study some very important technical features that apply to the design of reinforced concrete structures, also to study the possibility of reducing the consumption of cement for benefiting the same concrete and with the better quality. In this case the expected results will be: the reduction of the cost of concrete, maintenance of equipment for the production and placing the right concrete in contraction.

KEYWORDS: Fly ash, Concrete, Portland Cement, light concretes, environment, Economy.

1 INTRODUCTION

In Kosovo most of the electrical energy , 97%, is produced by burning coal and only 3% is Hydroelectric [6]. All stored and grace of planned generation facility is not being used as ingredient in making concrete to reduce the use of Portland cement in concrete production. Mainly the fly ash consists of silica (SiO_2), aluminum oxide (Al_2O_3), iron oxide (Fe_2O_3)

and calcium oxide (C_aO). Therefore, replacing cement with grace Portlant cement reduces the planned generation facility and in this case Portlant reduced CO_2 emissions in the atmosphere. According to the results for each ton of cement produced Portlant released a ton of CO2. Fly ash is classified in two classes: Class F and Class C. The main criteria is the requirement that the classification is chemical $SiO_2+Al_2O_3+Fe_2O_3 \geq 70\%$ for Class F and $SiO_2+Al_2O_3+Fe_2O_3 \geq 50\%$ for Class C.

The purpose of this paper is to explore the planned generation facility settings residual ash from Kosovo A and Kosovo B power plants in order to use it as a partial substitute up to 33% [European Standards EN 206-1] Portlant cement. The whole process will result with an environmental protection from the exposed position of the planned generation facility ash, concrete cost reduction and less emission of CO_2 by the production of the Portland cement.

When other materials, primarily fly ash and ground granulated blastfurnace slag, were introduced, they were viewed as replacements or substitutes for cement, and their influence and performance were judged against the standard of conrete containing only portland cement.

2 USES OF COAL IN THE WORLD

The five largest coal users - China, USA, India, Russia and Japan - account for 76% of total global coal use.

Table 1 - Coal in electricity generation

Coal in Electricity Generation		
South Africa 93%	Poland 87%	PR China 79%
Australia 78%	Kazakhstan 75%	India 68%
Israel 58%	Czech Rep 51%	Morocco 51%
Greece 54%	USA 45%	Germany 41%

3 HOW IS COAL CONVERTED TO ELECTRICITY

The simple technological scheme of production of ash.

Coal is first milled to a fine powder, which increases the surface area and allows it to burn more quickly. In these pulverised coal combustion (PCC) systems, the powdered coal is blown into the combustion chamber of a boiler where it is burnt at high temperature (see diagram below). The hot gases and heat energy produced converts water – in tubes lining the boiler – into steam.

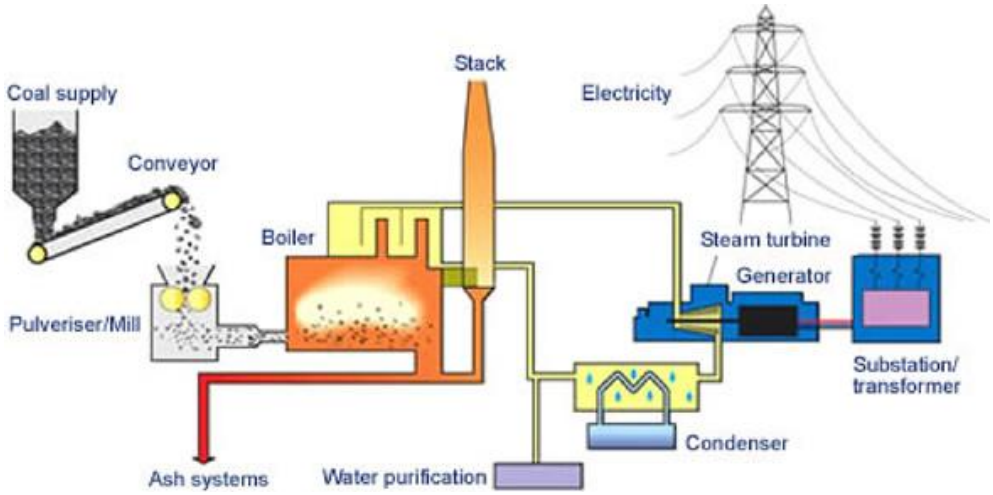

Figure 1 - The process of waste ash

4 THE USE OF FLY ASH IN CONCRETE

4.1. The coefficient "k"

Fly ash improves workability, reduces heat of hydration in fresh concrete and reduces water demand.
Instead of using the ratio w / c equivalent to the expression (1.1), [European Standards EN 206-1] [European Standards EN 450] entering the value '*k*':

$$\left(\frac{w}{c+k\cdot fly\ ash}\right) \tag{1.1}$$

where:
w – water
c – Portland cement
k – coefficient.

The value of the coefficient *k* depends not on the fly ash but the type of cement, and it is defined in 0,2 and 0,4 CEM I [3]:

CEM I 32,5	*k*=0,2
CEM I 42,5 and higher	*k*=0,4

Taking into account the value of the coefficient *k* maximum amount of fly ash must replenish the report:

Fly Ash / Cement $\leq$ 0,33 by mass

5 LABORATORY TEST

5.1. Materials

5.1.1. Cement

The cement that was used for the preparation of samples was CEM I 52.5.

5.1.2. Aggregate

Aggregates from quarries using genes from three different factions with D_{max}=16mm':

Fraction I: 0-4 mm' Fraction II: 4-8 mm' dhe Fraction III: 8-16 mm'.

5.1.3. Fly Ash

Fly ash was taken from Kosovo B power plant in order to measure volume 2.56 gr/cm3 / by chemical-physical analysis made in ZAG Lublana laboratory in Sllovenia /.

5.1.4. Additive

Hyper plast additive / TKK /.

5.2. Recipes and preparation of samples

To analyze the impact of the planned generation facility the fly ash compressive strength in concrete made some evidence with different consumption planned generation facility fly ash and Portland cement CEM I 52.5. Samples that were produced like Portland cement, were replaced by 30% of planned generation facility Fly Ash, by changing the quantity of Portland cement participation. Samples were made in a working environment with constant temperature and also by measuring the temperature of fresh concrete, pre sampling consistency and weight of the samples at the time of taking them with fresh concrete. Samples are 15x15x15 cm cubes.

Table 2 Composition of concrete, with varying amounts of Fly Ash and Cement

	Cement [kg/m^3]	Fly Ash [kg/m^3]	Fly Ash/C	W	Aggregate [kg/m^3]	Additive [kg/m^3]
					Fraksioni I, II, III	
Mix 1	260	0	0	226	1875	0
Mix 2	200	60	0.3	222	1867	1.3
Mix 3	300	90	0.3	220	1768	1.8

Figure 1: Fly Ash


Figure 2: Temperature


Figure 3: Consistency

Figure 4: Concrete mixture

Figure 5: Mass of wet concrete

Figure 6: Maintenace of the samples [4]

5.3. Weight of sample [gr] volume and weight [kg/m^3]

Table 3

Mix 1	m_0 [gr]	δ_0 [kg/m^3]
Samples 1-1	7861	2340
Samples 2-1	7779	2320
Samples 3-1	7956	2370
		δ=2343

Mix 2	m_0 [gr]	δ_0 [kg/m^3]
Samples 1-2	7861	2329
Samples 2-2	7848	2330
Samples 3-2	7847	2330
		δ=2330

Mix 3	m_0 [gr]	δ_0 [kg/m^3]
Samples 1-3	7877	2334
Samples 2-3	7889	2337
Samples 3-3	7975	2363
		δ=2345

	Consistency of concrete S [mm']	t_c ^{0}C	t_{env} ^{0}C
Mix 1	90	19	22
Mix 2	120	19	22
Mix 3	200	20	22

5.4. Results obtained from the compressive strength

Tabele 4 Testing of concrete samples [European Standards EN 12390]

Compressive strength		t - day		
		3	7	28
Mix 1 [Mpa]	Samples 1-1	13,23		
	Samples 1-2		18,44	
	Samples 1-3			22
Mix 2 [Mpa]	Samples 2-1	31,60		
	Samples 2-2		41,38	
	Samples 2-3			48,83
Mix 3 [Mpa]	Samples 3-1	14,06		
	Samples 3-2		18,70	
	Samples 3-3			22,25

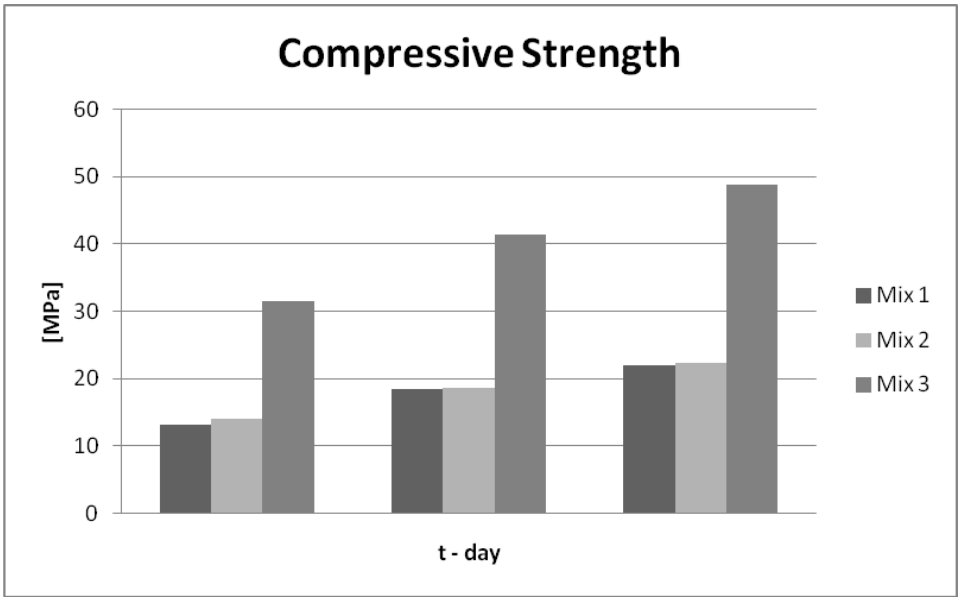

Figure 7: Compressive Strength Graph

6 CONCLUSION

Based on the fact that Fly Ash is a material which is planned generation facility, it is expected to decline the module of elasticity and thus increase the flow coefficient. Because of the amount of cement reduction, with contraction deformities, especially in the initial stage, it can be reduced. In this case flaws that arise as a result of the heat of cement hydration can be eliminated. . One of the most important aspects of the use of fly ash in concrete is the fact that, in general, the use of fly ash obviously improves the properties of freshly mixed concrete.

REFERENCES

European Standards EN 206-1 / European Standards EN 450 / European Standards EN 197 / European Standards EN 12350 / European Standards EN 12390

Independent Commission for Mines and Minerals, Rep. of Kosova

A.M. Neville. Properties of Concrete“ – Fourth Edition

K. Wesche. Fly Ash in Cocrete Properties and Performance“

Web-1: http://www.worldcoal.org/coal/uses-of-coal/

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