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Abstract. In this paper we have analyzed the Ash deriving from the residue of burnt coal in Kosovo Power Plants, especially in Power Plant "Kosova B". Given the large amount of Ash deriving from the combustion of coal and which is left as residue (redundancy), it was considered as necessary to carry out a study about the impact of Fly Ash in the reduction of Concrete production cost, but always having in mind to preserve the quality of concrete. The study is undertaken in accordance with the requirements of European standards. European Standard SK EN 206-1, EN 450-1 and EN 450-2. The Fly Ash is used as a supplementary of cement material in the production of concrete from Portland cement. As such, it had the impact of reducing the amount of cement used for a significant percentage. In addition to having an impact in cost reduction, the use of Fly Ash will also have an impact on the preservation of environment in two ways: one, by removing the ash from the landfills, because due to winds the ash is spread into the environment; and, two, it will contribute to reducing CO_2 emissions from the production of cement.

Keywords: Fly ash, Portland Cement, Concrete, Economy, Environment,etc..

1 Introduction

Fly ash is pozzolanic material and it improving the properties of concrete like compressive strength and Durability.
The results of study by Joshi et al (1994), indicated that with fly ash replacement level up to 50% by cement weight, concrete with 28 days strength ranging from 40 to 60 MPa and with adequate durability can be produced with cost saving of 16% by 50% replacement level.
The study examines the potential of fly ash as cement replacement in concrete. The objectives are to reduce the amount of ordinary Portland cement needed in building construction so as to achieve economic construction and sustainable development through the preservation of the environment.
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.
Fly ash is classified in two classes: Class F and Class C.
For Class F: $SiO_2+Al_2O_3+Fe_2O_3 \geq 70\%$ and for Class C: $SiO_2+Al_2O_3+Fe_2O_3 \geq 50\%$.
Fly ash concrete has also been praised for its environmental benefits as a "green" building material—putting to use an energy production byproduct that reduces the demand for carbon-intensive portland cement and requires less water in the hydration process [9].

2 Coal fly ash in Kosova

In Kosovo most of the electrical energy , 97%, is produced by burning coal and only 3% is Hydroelectric [6] because in Kosova the current electricity production is based on coal burning Power Plants "Kosova A" (with blocks A1, A2, A3, A4, A5) and "Kosova B" (with blocks B1, B2).

Figure 1. Power Plant Kosova A

Figure 2. Power Plant Kosova B

Figure 3. Landfills of ash [10]

Fly ash production during the period 2005-2008 by power plant “Kosova A” and “Kosova B” [10].

Table 1. Quantities of ash as product of the work in power plants of Kosova

Div. of generation	Year / Unit	2005	2006	2007	2008
Power plant Kosova A	t/y	232618.7	321577	438272.32	376179
	t/MW	0.293	0.3109	0.315	0.27
Power plant Kosova B	t/y	820362.7	726559.4	723183.10	784992
	t/MW	0.232	0.227	0.219	0.21
Sum (A+B)	t/y	1052981.4	1048136.4	1161455.42	1161171
	t/MW	0.2409	0.24241	0.267	0.24

The total amount of ash is about 40 million tons, in both landfills [10].

3 The use of fly ash in concrete

Fly ash has been used for many decades in concrete. Today, regulations and standards exist for the use of fly ash in concrete.
European standard for Fly Ash, EN 450-1, EN 450-2 and for concrete EN 206-1.
Fly ash can partly replace Portland cement in concrete.
The maximum amount of fly ash [1]:

$$fly\ ash/cement \leq 0{,}33\ by\ mass$$

Ratio w/c takes a new form (1) [1], [2]:

$$\frac{w}{(c + k \cdot fa)} \quad \ldots (1)$$

where:
w – water
c – Portland cement
k – coefficient.
fa – fly ash

The value of the coefficient k depends of cement, CEM I [3]:

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

4 Effects of fly ash on the properties of fresh concrete

Fly ash is a pozzolanic material and fly ash has lower unit weight than Portland cement.
Benefits of using fly ash in fresh concrete include: workability, bleding, air content, setting time, pumpability, finishability.

5 Impact of Fly Ash on Concrete production cost Effects

In the tables and diagrams, is presented production cost of concrete without fly ash and with different amounts of fly ash. Prices for concrete components are taken from the actual market.

Table 2. Mix 1 and Cost

Mix 1	[kg/m3]	Price €	Sum €
Aggregate	1768	0.01	17.68
Portland cement CEM I 52.5	300	0.1	30
Water: Potable water	200	0.00045	0.09
Fly Ash: TPP "Kosova B"	0	0.0018	0
Aditiv	1.5	2	3
		Cost €	50.770

Table 3. Mix 2 and Cost

Mix 2	[kg/m3]	Price €	Sum €
Aggregate	1804	0.01	18.04
Portland cement CEM I 52.5	280	0.1	28
Water: Potable water	220	0.00045	0.099
Fly Ash: TPP "Kosova B"	84	0.0018	0.1512
Aditiv	1.8	2	3.6
		Cost €	49.890

Table 4. Mix 3 and Cost

Mix 3	[kg/m3]	Price €	Sum €
Aggregate	1830	0.01	18.3
Portland cement CEM I 52.5	260	0.1	26
Water: Potable water	200	0.00045	0.09
Fly Ash: TPP "Kosova B"	78	0.0018	0.1404
Aditiv	2	2	4
		Cost €	48.530

Table 5. Mix 4 and Cost

Mix 4	[kg/m3]	Price €	Sum €
Aggregate	1872	0.01	18.72
Portland cement CEM I 52.5	225	0.1	22.5
Water: Potable water	200	0.00045	0.09
Fly Ash: TPP "Kosova B"	75	0.0018	0.135
Aditiv	2	2	4
		Cost €	45.445

Table 6. Mix 5 and Cost

Mix 5	[kg/m3]	Price €	Sum €
Aggregate	1864	0.01	18.64
Portland cement CEM I 52.5	200	0.1	20
Water: Potable water	225	0.00045	0.10125
Fly Ash: TPP "Kosova B"	60	0.0018	0.108
Aditiv	1.3	2	2.6
		Cost €	41.449

Table 7. Cost for mixtures

Mix Design	Total €
Mix 1	50.770
Mix 2	49.890
Mix 3	48.530
Mix 4	45.445
Mix 5	41.449

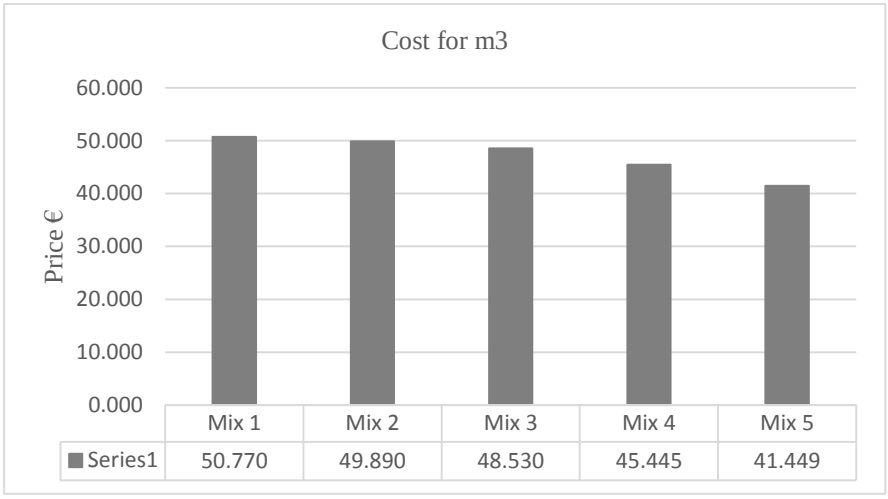

Table 8. Cost for 50000m3 production concrete per year

Mix Design	Cost/m3	m3	Total €
Mix 1	50.770	50000	2538500
Mix 2	49.890	50000	2494510
Mix 3	48.530	50000	2426520
Mix 4	45.445	50000	2272250
Mix 5	41.449	50000	2072463

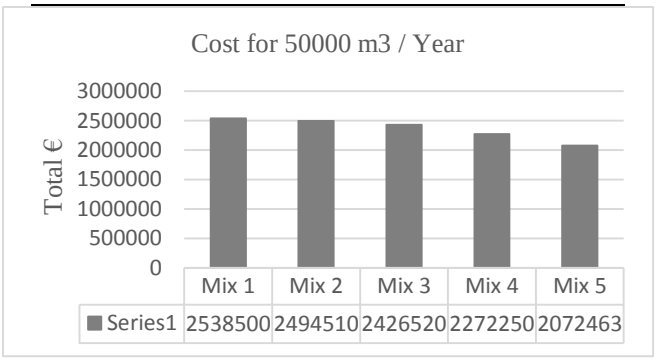

Table 9. Impact of Fly Ash

Mix Design	Cost/m3	m3	Total €
Mix 5	41.449	50000	2072463
Mix 4	45.445	50000	2272250
Mix 3	48.530	50000	2426520
Mix 2	49.890	50000	2494510
Mix 1	50.770	50000	2538500

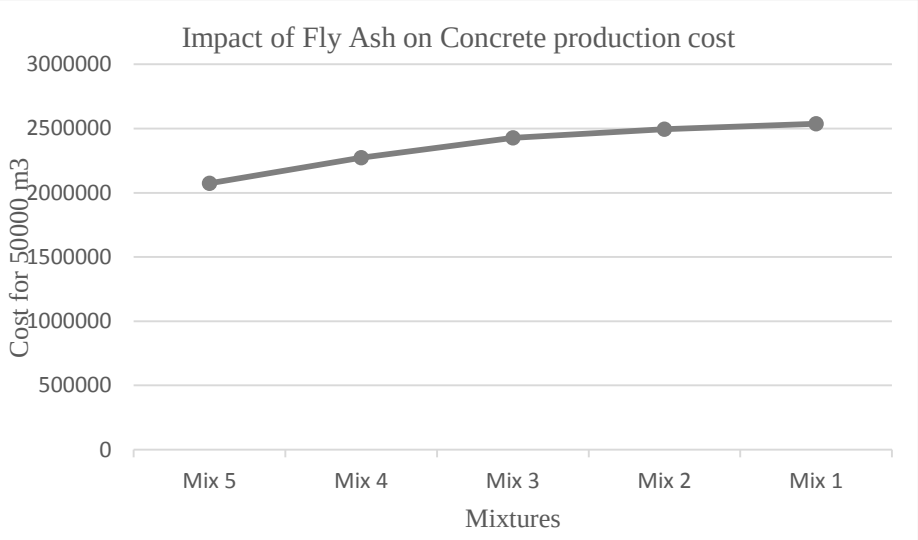

Table 10. Estimated cost savings

Minus	Mix 1 C=300kg/m3 Fly Ash=0	Mix 2 C=280kg/m3 Fly Ash=84kg/m3	Mix 3 C=260kg/m3 Fly Ash=78kg/m3	Mix 4 C=225kg/m3 Fly Ash=75kg/m3	Mix 5 C=200kg/m3 Fly Ash=60kg/m3
Mix 1	0	43990	111980	266250	466038
Mix 2		0	67990	222260	422048
Mix 3			0	154270	354058
Mix 4				0	199788
Mix 5					0

Table 11[1]. Estimated Cost Savings to State DOTs of Using Fly Ash (FA) Concrete ($ Millions)

State	Percentage of concrete that includes fly ash	Total value of concrete products, 2005 to 2010	Total value of bids, 2005 to 2010	Estimated cost savings from using fly ash in concrete	Total estimated value of bid tabs without

					fly ash, 2005 to 2010
California	100%	$3,266.60	$16,871.00	$555.30	$17,426.30
.	.	.	.	.	.
Florida	95%	$983.90	$10,300.60	$158.90	$10,459.50
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
New York	70%	$682.90	$8,164.20	$81.30	$8,245.50
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.
Total		$15,778.40	$107,675.60	$2,319.50	$109,995.10

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