**Study of the addition of different ashes to cement: reactivity and resistance**

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**Highlights**

* The mixtures evaluated show similar behavior to the target
* The BIT-cement mixture presents better resistance after 90 days of curing
* Fly ash from hazardous waste can be used as a replacement for cement

**1. Introduction**

The world annual production of fly ash is estimated at around 780 million tons per year and has been used successfully in the cement industry for more than 50 years, mainly as a mineral additive in Portland cement concrete and also as a component of mixed cement[1]. They are composed mainly of amorphous silica and alumina [2] with a favorable diameter and size that improves workability and makes this material suitable, even, for the production of geopolymers [2]. Fly ash can be used partially as a substitute for Portland cement or applied as an addition to concrete in the batch plant [3,4]. The use of biomass ash and coal-biomass mixtures in cement has also been widely investigated [5,6]. In this work, the reactivity of hazardous waste, bituminous coal and sugar cane ash as supplementary cement materials was evaluated.

**2. Methods**

For this work, ash from incineration processes (hazardous waste, sugarcane and bituminous coal) was used. Each one of these ashes was used in different proportions in the mixture with cement. For the case of bituminous coal (BIT) and sugarcane (CAN), a 30% replacement ratio was used. In the case of the ashes of hazardous waste these were previously treated by means of washes (CITA). Both the treated and the untreated ashes were used in replacements. For the treated ashes two ratios of 5% and 3% were used. While for the untreated ashes a ratio of 10% was used. For this, the reactivity of the ashes in cement monoliths was analysed, focusing on thermogravimetric tests as a characterization technique to determine the present phases and compression resistance tests. The ashes were characterized by DRX and FRX, finding low content of SiO2 and Al2O3 in the hazardous waste ashes, while in the coal and sugarcane ashes high contents of these oxides were found. The monoliths were prepared according to ASTM C-305, using a 0.5 water/lime ratio. The hydration process was stopped with acetone at the ages of 1, 3, 7, 14, 28, 56 and 90 days.

**3. Results and discussion**

After 90 days of curing, it was found that the mixtures presented similar resistance data with white respite, highlighting the 3 and 5% RPL and the bituminous coal mixtures. Similarly, the 10% -RPS mixture has a load very similar to white. It is advisable to perform metal leaching analysis, in order to evaluate possible environmental impacts that may occur in its application as a substitute for cement. Table 1 shows the average of the three failures made to each of the samples on each of the days evaluated. A very good behavior of the mixtures is observed from day 3 of curing of the monoliths.

**Table 1.** Analysis of the resistance of the different replacements

|  |  |  |
| --- | --- | --- |
| **Day** | **Sample** | **Average Load (kgf)** |
| **90** | UHW(10%) | 844 |
| THW(5%) | 1055 |
| THW(3%) | 1094 |
| BIT | 1205 |
| CANA | 884 |
| WHITE | 789 |

In table 1, it can be seen that on day 1 only the sugar cane has a good resistance compared to the white, but as the curing time progresses, all the mixes present good behavior. In Figure 1, the reactivity of these ashes can be corroborated, in which in the temperature curve between 50 and 200 ºC, the formation of very marked peaks that are related to different types of C-S-H gels are observed.



**Figure 1.** Total mass lost for a given temperature interval (DTG) for different combinations of ash at 90 days of curing.

**4. Conclusions**

It is observed that the mixtures evaluated have a good resistance and reactivity behavior after 90 days of curing, the DTG curves show the same crystal formations as the white. Likewise, the resistance of all the evaluated monoliths is very similar or even better than those of the target.

**References**

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