The use of oil shale ash in construction and building materials

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Introduction

The chemical composition of oil shale ash can vary widely, ranging from high SiO₂ content, which is only pozzolanic in nature, to high CaO content which has cementitious properties on its own. Moreover, its mineral composition is similar as that of clay, which can replace clay to produce construction and building materials, such as portland cement, porous brick. This paper induced the methods of building materials.

| Raw material

During experiment process, oil shale ash was taken from Jilin province. The main properties of oil shale ash are as follows:

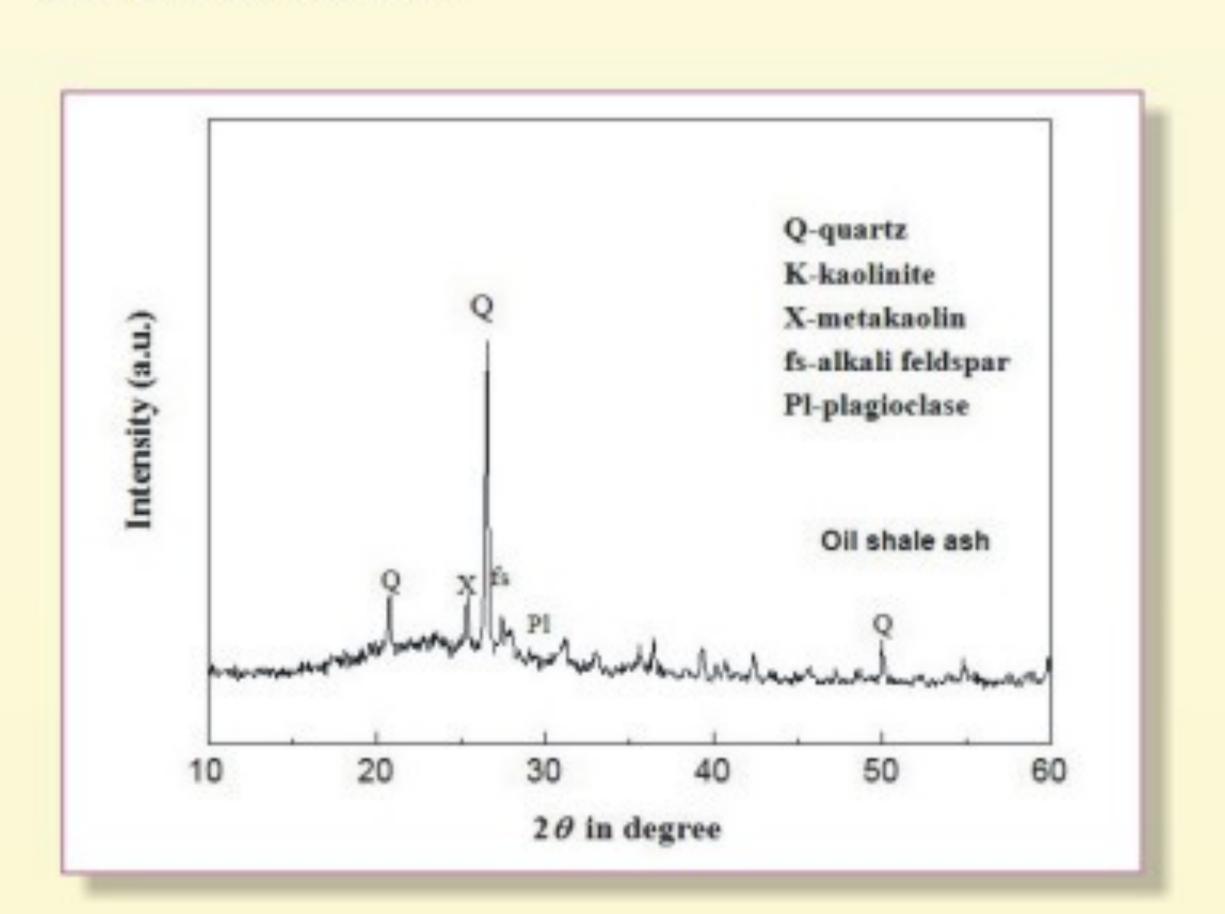


Table 1 Chemical compositions of oil shale ash

Component	Oil shale ash (wt.%)	
SiO ₂	51.66	
Al ₂ O ₃	23.22	
Fe ₂ O ₃	5.20	
CaO	3.38	
MgO	0.17	
K ₂ O	0.93	
Na ₂ O	0.11	

Figure 1 XRD patterns of oil shale ash

The XRD analysis of the oil shale ash is shown in Figure 1. The result indicates that the predominate minerals such as quartz, kaolinite exist in the sample. Moreover, the new peaks appeared in 20=25.2 for the calcined sample, which is the peaks of metakaolin. The main chemical compositions of the oil shale ash are given in Table 1, which indicates that it contains mainly around 20% alumina, 50% silica and iron oxide, calcium oxide and magnesium oxide along with some trace elements.

|| Experiment and Results

1 Producing portland cement

Using OSA as an additive was added into clinker to producing highgrade cement. The obtained results indicate that OSA doping of 10 wt.%, would yield the optimum compressive strength (51 Mpa), and flexural strength (8.1 Mpa).

Figure 2 The photo of cement

Figure 2 The photo of cement obtained in our laboratory

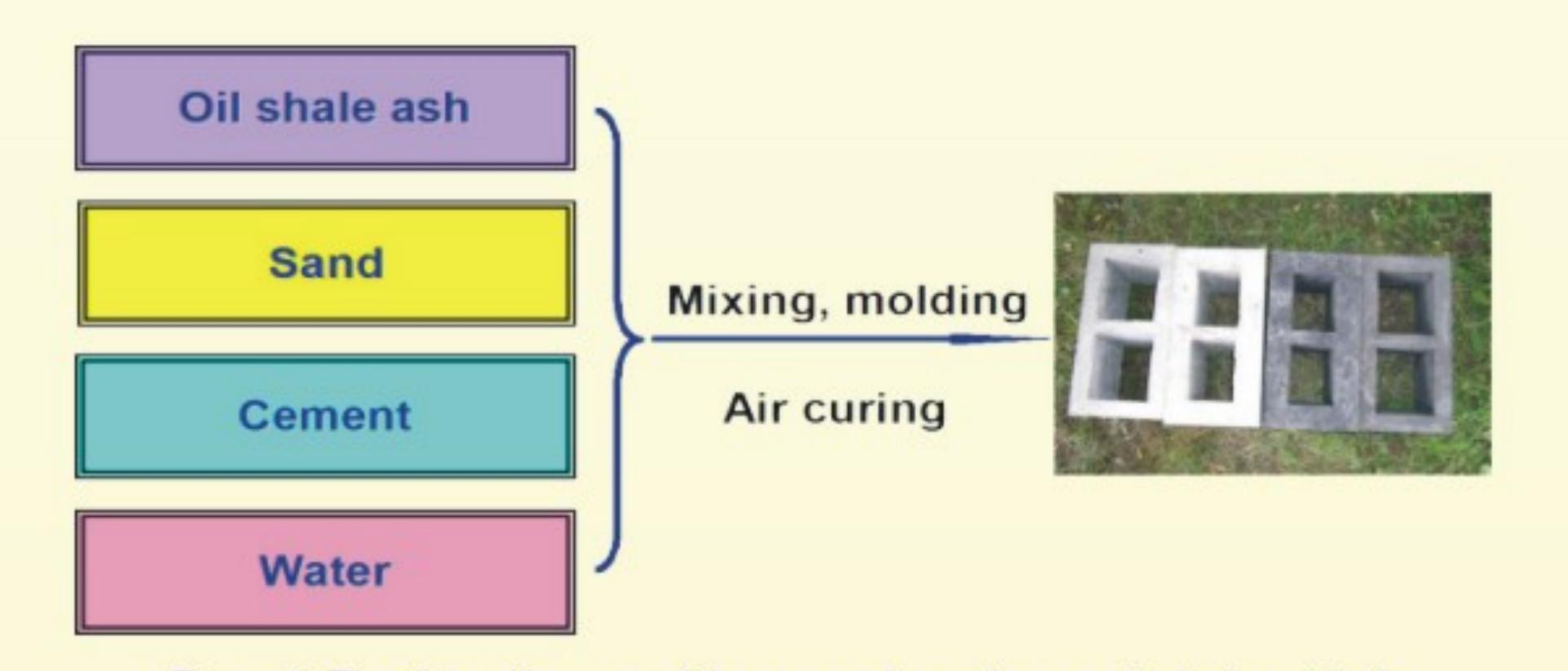


Figure 3 The flow diagram of the procedure of concrete hollow block

2 Producing concrete hollow block

2.1 Experimental procedure

The ingredients and the method of molding simulated standard manufacturing processes. The Figure 3 is the flow diagram of the procedure of concrete hollow block. Raw mixtures included oil shale ash, sand, cement and water. The mixing continued until the mixtures were homogeneous. The samples were molded in the standard mould and cured in following conditions: 28 days of atmospheric air curing (temperature:18 ~ 23 °C). In order to investigate the influence of the amount of oil shale ash on the compressive strength, the experiments were conducted by varying amount of oil shale ash from 30 to 70wt.% and fixing amount of cement and water.

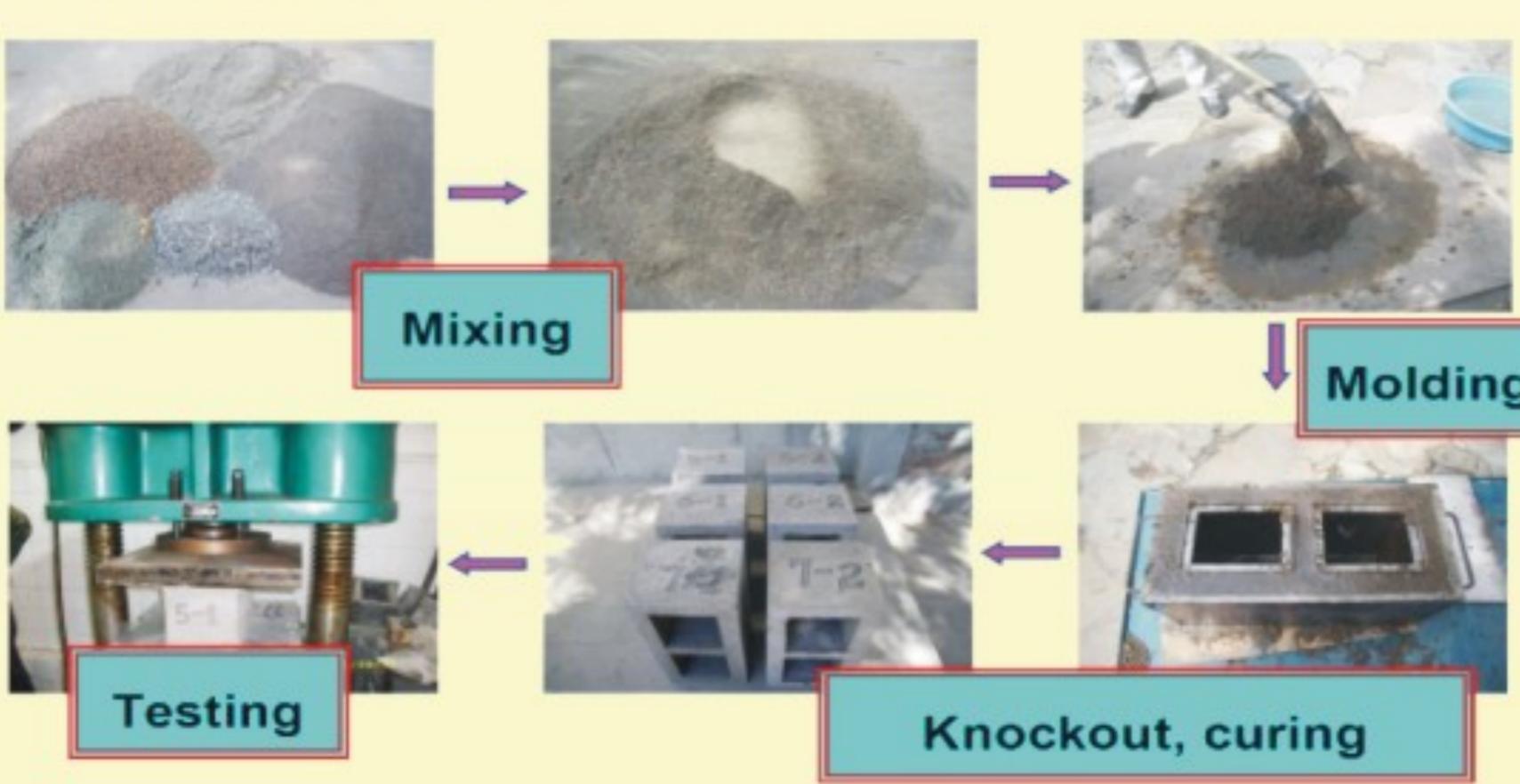


Figure 4 The photos during the experiment process.

2.2 The result of compressive strength

The compressive strength of samples obtained with different amount of oil shale ash was tested and the results are shown in Table 2 and Figure 5. It can be seen that the compressive strength of concrete hollow block is gradually decreased to a certain value with the amount of oil shale ash increasing (approximately, 50%), thereafter slightly increases. Compared with the national standard of block (Table 3), the strength grade is 3.5 ~ 5.0.

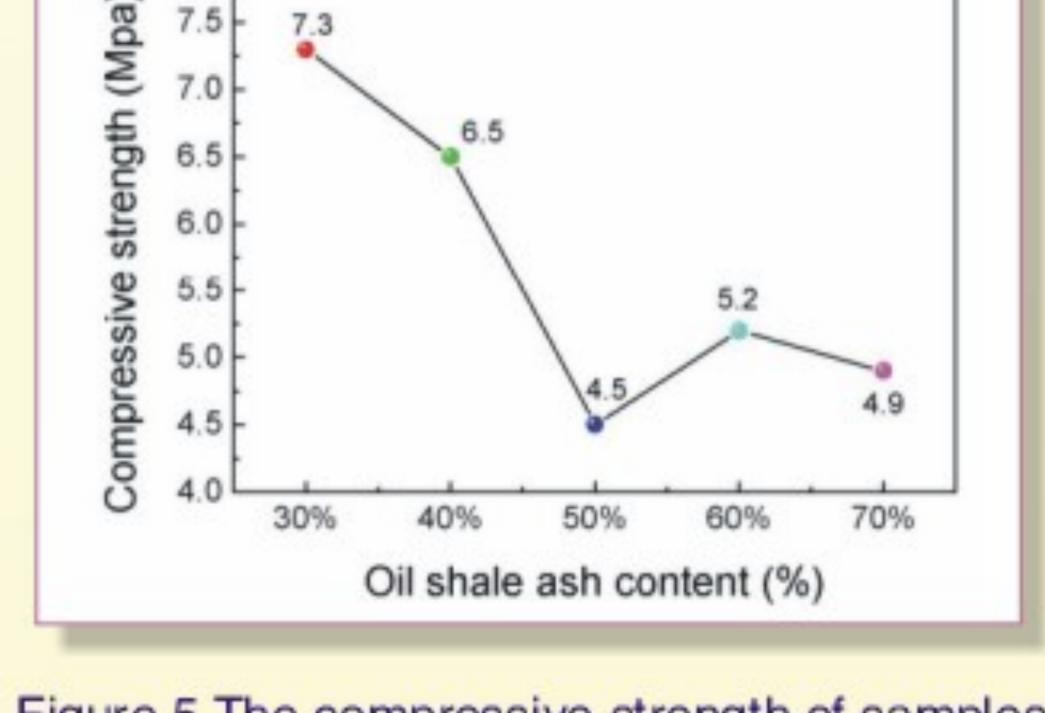


Figure 5 The compressive strength of samples

Table 2 Performance testing results of block

Content	Size	Strength (Mpa)	Density (Kg/m3)
30%	390*190*190	7.3	1065
40%	390*190*190	6.5	1044
50%	390*190*190	4.5	959
60%	390*190*190	5.2	913
70%	390*190*190	4.9	867

Table 3 National standard of block

Strength	C.M. (Mpa)		Density
	Average	Minimum	range
1.5	≥ 1.5	1.2	≤ 600
2.5	≥ 2.5	2.0	≤ 800
3.5	≥ 3.5	2.8	≤1200
5.0	≥ 5.0	4.0	
7.5	≥ 7.5	6.0	≤1400
10.0	≥ 10.0	8.0	

V Conclusion

In summary, the usage of the oil shale ash in construction and building materials will not only reduce their production cost but also solve the problem of oil shale ash heaping.