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The Implementation of Waste Sawdust in Concrete

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ABSTRACT

Nowadays, sawdust has been widely regarded as a sand replacement material to produce sawdust concrete. This thesis uses orthogonal test to analyze the mechanical and heat preservation as well as heat insulation property with the sawdust replacement ratio of 0%, 3%, 5%, 7%, 10%, respectively, to get an optimal sawdust replacement ratio. Besides, it also discusses the deficiencies of this research.

Keywords: Waste Sawdust; Concrete; Mechanical Property; Optimal Sawdust Replacement Ratio

1. Introduction

In recent years, China's urbanization construction is rapidly developing. Plenty of construction materials have been expended every year, which has been increasing sharply year by year. According to some previous researches, the construction material expending is about one third of the whole society's expense [1]. In order to cut down the exploitation of natural resource and environmental damage, it is urgent for us to accelerate the development of the environment-friendly construction materials.

The implementation of waste sawdust can not only decrease environmental damage, but also can save the concrete materials. It has many advantages over traditional concrete, such as low bulk density, better heat preservation and heat insulation property, and lower pollution for our environmental, etc. And the implementation of waste sawdust could also be generalized to the use of straw in countryside, which could create more environmental saving profit.

2. The Experimental Materials and Methods

2.1. The Experimental Materials

1) Cement: Made from Xinkang Cement factory, Ya'an, Sichuan. Composite Portland cement 32.5R, the physical properties can be seen in **Table 1**.

2) Waste sawdust: Collected from an abandoned wood factory. In terms of fineness, average grade is 0.25 - 0.5 mm after passing the sieves.

3) River sand and Macadam: Both meet the experimental requirements [2].

2.2. The Experimental Methods

Examine the physical properties of cement by GB/T 17671-1999 "*The examine method of cement mortar's strength*". The initial compressive strength of normal concrete is 25 MPa. Fabricate the specimens according to GBT50107-2010 "*The strength testing normal of concrete*", replacement sand ratio 0%, 3%, 5%, 7%, 10%. Every group has three specimens, and these samples were formed with vibration method. In addition the compressive strength was tested after standard curing. When testing its 28d's heat preservation and insulation property, using the same mixture ratio to fabricate the sample, which size is 400 × 400 × 30.

To study the monosaccharide's influence on concrete, devide the subjects into comparative group and experimental group, the experimental group has been boiled by distilled water that does not have monosaccharide. Both experimental and comparative group specimens have been dry with 170˚C for 3 h. Fabricate specimens with same mixture ratio that the replacement ratios are: 0%, 3%, 5%, 7%, 10%.

3. Experimental Results and Analyze

3.1. The Influence of Waste Sawdust Replacement Ratio on the Compressive Strength

The compressive strength of specimens' various periods can be seen in **Table 1**. And the comparison of monosaccharide group and non-monosaccharide can be seen in **Figure 1**.

It could be easily drawn that compared with the traditional concrete, which replacement ratio is 0%, with the increase of replacement ratio, the compressive strength gradually decreases. Because the monosaccharide could decrease the condensation between the cement and other materials of concrete, the compressive strength of non-monosaccharide group is higher than monosaccharide group.

3.2. The Influence of Waste Sawdust Replacement Ratio on the Thermal Conductivity

The thermal conductivity of specimens' various periods can be seen in **Tables 3** and **4**.

From **Tables 2** and **3**, we can find， compared with the traditional concrete, which replacement ratio is 0%, with the increase of replacement ratio, the compressive strength gradually decreases, which means the heat preservation and insulation property is better and better. Besides, in the same replacement ratio specimen, with the increase of measurement temperature, the thermal conductivity decrease, then increase. The lowest thermal conductivity is 15˚C. Therefore, the waste sawdust concrete could decrease the thermal conductivity and increase the heat preservation and insulation property.

3.3. The Thermal Conductivity Comparison of Monosaccharide Group and Non-Monosaccharide Group

From **Figures 2-4**, it is shown that the thermal conductivity of monosaccharide group is higher than non-monosaccharide group. The heat preservation and insulation property of monosaccharide group is better than non-monosaccharide group. For the non-monosaccharide group has better condensation between cement and other

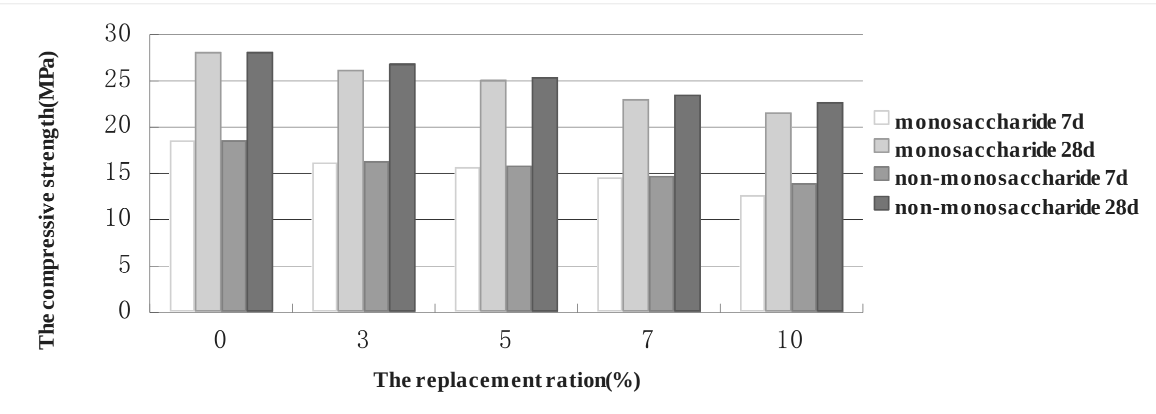

Figure 1. The comparison of monosaccharide group and non-monosaccharide.

Table 1. The physical properties of cement.

normal consistency	setting time/min		stability	compressive strength/Mpa		bending Strength/Mpa	
%	initial set	permanent set	Patters	7d	28d	7d	28d
25	220	360	qualified	19.81	34.51	5.24	8.16

Table 2. The compressive strength of specimens.

The replacement ratio (%)	monosaccharide		non-monosaccharide	
	7d	28d	7d	28d
0	18.58	28.15	18.58	28.15
3	16.16	26.13	16.25	26.88
5	15.66	25.15	15.78	25.36
7	14.58	23.03	14.67	23.46
10	12.65	21.55	13.87	22.68

Table 3. The thermal conductivity of specimens monosaccharide group.

The replacement ratio (%)	Hot plate temperature (˚C)	Measurement temperature (˚C)	Cold temperature (˚C)	Specimens' thickness (mm)	Thermal conductivity (W/m·k)
	30	25	20		0.445158
0%	25	20	15	30.5	0.443619
	20	15	10		0.450052
	30	25	20		0.429392
3%	25	20	15	30.5	0.423642
	20	15	10		0.427028
	30	25	20		0.413899
5%	25	20	15	30.3	0.410792
	20	15	10		0.413567
	30	25	20		0.397242
7%	25	20	15	31.2	0.391134
	20	15	10		0.396983
	30	25	20		0.381023
10%	25	20	15	29.9	0.378798
	20	15	10		0.380011

Table 4. The thermal conductivity of specimens non-monosaccharide group.

The replacement ratio (%)	Hot plate temperature (˚C)	Measurement temperature (˚C)	Cold temperature (˚C)	Specimens' thickness (mm)	Thermal conductivity (W/m·k)
	30	25	20		0.445158
0%	25	20	15	30	0.443619
	20	15	10		0.450052
	30	25	20		0.421215
3%	25	20	15	30	0.413665
	20	15	10		0.426011
	30	25	20		0.410853
5%	25	20	15	30	0.408673
	20	15	10		0.412037
	30	25	20		0.401243
7%	25	20	15	30	0.392412
	20	15	10		0.401102
	30	25	20		0.379812
10%	25	20	15	30	0.373242
	20	15	10		0.378421

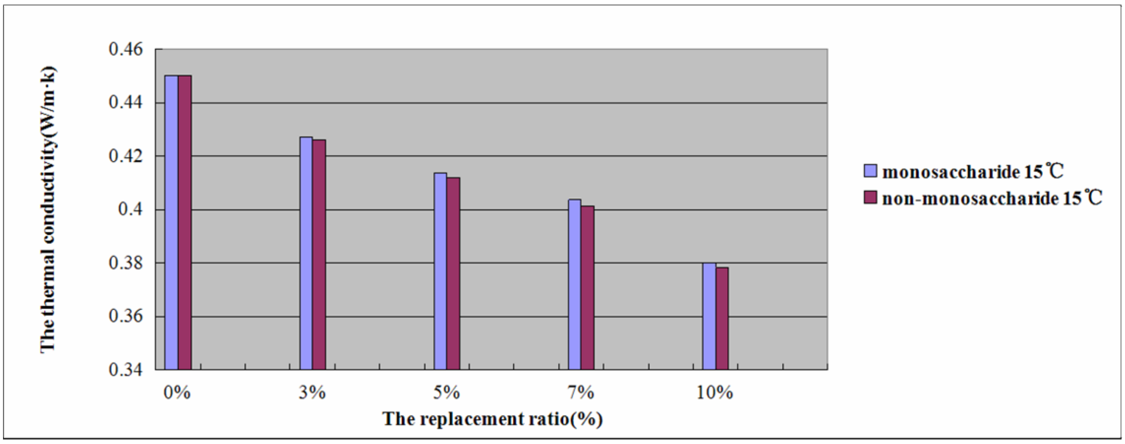

Figure 2. The thermal conductivity comparison of monosaccharide group and non-monosaccharide with measurement temperature 15˚C.

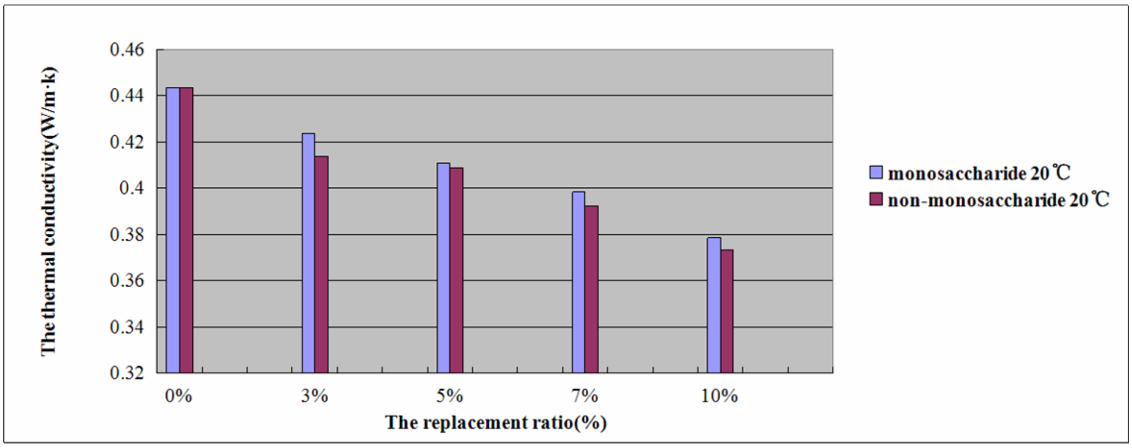

Figure 3. The thermal conductivity comparison of monosaccharide group and non-monosaccharide group with measurement temperature 20˚C.

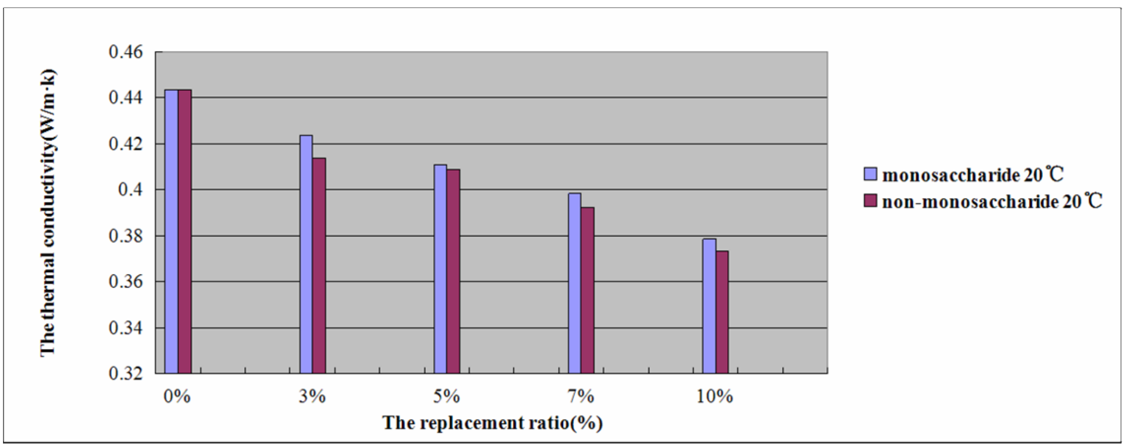

Figure 4. The thermal conductivity comparison of monosaccharide group and non-monosaccharide group with measurement temperature 25˚C.

materials. It could reduce the pores of concrete, which could be harder for heat transferring from hot plate to cool plate [3].

4. Conclusion and Summary

The paper studies the influence of different replacement rations on the compressive strength and thermal conductivity to get the change rule of compressive and thermal conductivity with the change of sawdust replacement ratio. And it also studies the influence of monosaccharide on the condensation property. With the increase of replacement ratio, the compressive strength gradually decreases [4]. When the replacement ratio is 5%, the compressive strength could meet the C25, and the heat preservation and insulation property are also highly better than those of traditional concrete. The 5% could be seen as an optimal replacement ratio. If the replacement ratio is much higher, it could also be used as non-bearing component.

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