

# Lightweight Brick by Carbon Ash from The Mixed Plastic Waste Treatment Plant

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**Abstract.** This study was designed to investigate the mixed plastic waste from the production of light carbon ash bricks performance. The mixed waste plastic pyrolysis process generated waste - Carbon ash. After extrusion, a Lightweight brick was made by carbon ash, additive and Cement mortar. In general, the set compressive strength and insulation effect of lightweight bricks with carbon ash proportion for significant impact. The set water absorption and thermal conductivity of lightweight bricks with carbon ash proportion for significant impact. The set density of lightweight brick ameliorates with M3824 additive and CM3 cement mortar for significant impact. Under conditions of technology and economic, the results of this study as reference for market-oriented marketing and commercialization of production.

## 1 Introduction

Lightweight concrete classification quite a variety of types, such as the United States uses in accordance with ASTM(American Society for Testing and Materials) divided into structural body, Precast concrete board and Sound absorption heat insulation purposes; German national standard DIN (Deutsches Institut fur Nor-mung) to distinguish density, the upper limit of  $2000\text{kg} / \text{m}^3$ ; Japan national standard JIS (Japanese Industrial Standards) to aggregate source area divided into natural, artificial and Industrial side products.[1][2]

Lightweight concrete with the following characteristics:

## 2 The density of light

Differ between countries for lightweight concrete density standard, but density is not more than 2000. In commercial production, the mixing proportion lightweight concrete and standard concrete is 100: 20~45, with more excellent performance. Lightweight concrete use in the building structure, density must be higher than before 1200 to meet the expected characteristics. Therefore, commercially available lightweight concrete products, production process control regarded product density between  $1400\sim 1800\text{kg}/\text{m}^3$ .

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### 3 Excellent thermal insulation effectiveness

Thermal transmission of the way can be divided into thermal conduction, convective heat and radiant heat. Thermal conduction heat transfer is the main way of concrete, such as ordinary concrete and brick thermal conductivity of between  $1.0\sim 1.5 \text{ Wm}^{-1}\text{K}^{-1}$ . Such as lightweight aggregate having porous characteristics, so the thermal conductivity can be reduced to  $0.1\sim 1.0 \text{ Wm}^{-1}\text{K}^{-1}$ . At present, some buildings have facades made of lightweight concrete, so the building has good insulation effect, effectively reducing the energy consumption of air conditioning.

### 4 Compressive strength trustworthy

Both the density and the compressive strength of lightweight concrete is absolutely relevant. In CNS3691 and ASTM C330 has a detailed specification for compressive strength properties and density as the grade scale. The ratio between the compressive strength and density of lightweight concrete is to assess the quality of an important basis.[3]

Carbon ash is a byproduct of the waste mixed plastic pyrolysis recycling process. Waste mixed plastic pyrolysis process, which can produce 50% green diesel, 20% carbon ash, 20% combustible gas and 5% tar. The main Component of the carbon ash was 65% ash, 20% carbon, 5% gum and 6% metallic oxide. The main metallic oxide contains Fe, Ca, Al, Cu, Mn. After mixing plastic waste pyrolysis process, reduce the volume, but also can prevent environmental pollution and ecological damage.[5][6]

Research scholars and experts in the past pointed out that although waste mixed plastic carbon ash having a large surface area, but the composition contains a large amount of ash and volatile organic substances. Therefore, the waste mixed plastic carbon ash cannot be re-used as industrial raw materials, the use of waste mixed plastic carbon ash severely limited, so how to solve the re-use of waste mixed carbon ash, but today's important issues.[3][4]

## 5 Research methods

### 5.1 Sources of waste mixed plastic carbon ash

The waste mixed plastic carbon ash by ZKHN Environmental Protection the Energy Technology Co., Ltd. by production of China Shantou, sources of waste mixed plastic in China. Carbon ash is no commercial value in this market, must be treated as waste, not only need to pay removal costs, also contributed to rising corporate operating costs. Carbon black homogenization tests to ensure the credibility of the experiment. After the carbon ash is broken, with 10mesh screening machine screening, so that carbon ash Size consistency. Carbon ash crushed by 10mesh screening machine for screening, so that carbon ash Size consistency. The properties of three kinds of carbon ash proportion are as Table 1.

Table 1 Characteristics Of Carbon Ash Proportion

Product No.	Ash20	Ash30	Ash40
Carbon ash adding weight proportion	20%	30%	40%
Cement mortar adding weight proportion	80%	70%	60%
Slump	130mm	150mm	170mm
Chloride ion content	$0.09\text{kg/m}^3$	$0.10\text{kg/m}^3$	$0.09\text{kg/m}^3$

## 5.2 Select the additive

From lightweight concrete quality standpoint, lightweight aggregate and concrete is able to close bonding is the key. Therefore, the additive for lightweight concrete physical properties (compressive strength and the cohesive strength) has a significant correlation. Lightweight aggregate additives principal component include the acrylic series additive, polymer additives and lignin material series additives. The properties of three kinds of additive are as Table 2.

Table 2 Characteristics Of Lightweight Concrete Additive

Product No.	M3824	QG182	GA163
Category	Acrylic series	Polymer series	Lignin Series
Appearance	Transparent Gel	Powder	Brown liquid
Operating viscosity	100-1200cps	1000-1800cps	100-800cps
Thinner	Water	Water	Water
Odor	Odorless	Resin odor	Aromatic odor
Add proportions	1-1.5%	2%	4%
Characteristics	Strong cohesion	Strong cohesion	Slightly weaker cohesion
	Colorless and transparent after drying	Yellowish and transparent after drying	Brownish and transparent after drying
	Good weather resistance	Easily cracked	
	No pollution Good operating characteristics		
Additive Producer	Our laboratory	ZKHN Ltd	KQ Chemical

## 5.3 Cement mortar proportion

Cement mortar is composition by mixing sand and a selection of aggregates with a specified amount of water. The Cement mortar can be used for a number of applications, such as plastering over bricks, Wall smooth or other forms of masonry. The properties of three kinds of cement mortar proportion are as Table 3.

Table 3 Cement Mortar Composite Formulation

Formulation	Cement	Sand	Water
CM1	300	750	120
CM2	250	750	105
CM3	300	600	120

## 6 Results and Discussion

### 6.1 Density characteristics of lightweight concrete brick

Density experimental data, only additive to cement mortar types have significant relevance. When using the M3824 additives, lightweight concrete brick density of about 700 to 800 Kg/m<sup>3</sup>; use QG182 with GA163, the density of lightweight concrete is about 900 to 1100 Kg/m<sup>3</sup>. Different types of cement mortar itself have a density difference, the composition of lightweight concrete brick, and cement mortar proportion of 60 to 80%. Thus, the type of cement mortar for lightweight concrete brick density also has relevance.

## 6.2 Water absorption characteristics of lightweight concrete bricks

Experimental data of water absorption, only the amount of additives and carbon Ash have significant relevance. When using the M3824 additives, water absorption of lightweight concrete brick is about 3.7 to 4.3%; use QG182 with GA163, the water absorption of lightweight concrete is about 8.3 to 19.7%. M3824 chemical additives belonging to acrylic gel, with waterproof function, so the moisture barrier has a significant effect. Composed of lightweight concrete brick, carbon ash percentage of 20 to 40%, carbon ash not only does not absorb water, and there is a barrier to moisture effect, so the water absorption of lightweight concrete bricks also has relevance.

## 6.3 Compressive strength characteristics of lightweight concrete bricks

The compressive strength of the experimental data, only cement mortar types have significant relevance. When using CM3 cement mortar, lightweight concrete brick compressive strength of about 102 to 110 Kg/cm<sup>2</sup>; The higher cement content of cement mortar compressive strength is stronger.

## 6.4 Thermal conductivity characteristics of lightweight concrete bricks

Thermal conductivity of experimental data, only the amount of carbon ash has significant relevance. When adding 40% ash, lightweight concrete brick thermal conductivity of about 0.31 to 0.33 Wm<sup>-1</sup>K<sup>-1</sup>; When adding 30% ash, lightweight concrete brick thermal conductivity of about 0.35 to 0.40 Wm<sup>-1</sup>K<sup>-1</sup>; When adding 20% ash, lightweight concrete brick thermal conductivity of about 0.36 to 0.43 Wm<sup>-1</sup>K<sup>-1</sup>. carbon ash has blocked the thermal conduction characteristics, and therefore the more significant carbon ash added to lower the Thermal conductivity, blocking heat transfer, making lightweight concrete bricks with an insulating effect.

Table 4 The Basic Properties Of Lightweight Concrete Bricks

Additive	Carbon ash proportion	Cement mortar proportion	Density	Water absorption	Compressive strength	Thermal conductivity
			Kg/m <sup>3</sup>	%	Kgf/cm <sup>2</sup>	Wm <sup>-1</sup> K <sup>-1</sup>
M3824	Ash20	CM1	880	4.3	107	0.42
		CM2	817	4.1	105	0.43
		CM3	743	3.4	110	0.42
	Ash30	CM1	836	4.3	103	0.36
		CM2	799	4.3	104	0.35
		CM3	724	3.6	109	0.37
	Ash40	CM1	819	4.3	102	0.31
		CM2	786	4.4	101	0.31
		CM3	714	3.7	107	0.31
QG182	Ash20	CM1	983	11.1	97	0.42
		CM2	915	9.6	97	0.43
		CM3	897	7.2	104	0.41
	Ash30	CM1	933	11.4	98	0.40
		CM2	887	9.9	97	0.41
		CM3	863	7.9	103	0.38
	Ash40	CM1	925	12.9	96	0.35
		CM2	874	10.7	96	0.37
		CM3	835	8.3	104	0.35

GA163	Ash20	CM1		1094	18.1	86	0.36
		CM2		1007	18.6	87	0.34
		CM3		960	18.3	101	0.37
	Ash30	CM1		1019	17.1	88	0.34
		CM2		989	17.9	87	0.35
		CM3		948	17.8	103	0.36
	Ash40	CM1		1007	19.6	88	0.33
		CM2		967	19.4	88	0.32
		CM3		933	19.7	102	0.33

## 6.5 Lightweight concrete brick optimal production conditions

According to the above results, we know that the best lightweight concrete brick production conditions: M3824 additives, carbon ash added 40% (Ash40) and CM3 cement mortar (cement: sand: water = 300: 600: 120). Under the above conditions to produce lightweight concrete brick not only has the characteristics of low density, construction transport more convenient, the more help reduce the load floor. In terms of water absorption, water absorption of lightweight concrete brick in this study was 3.7%, much lower than brick water absorption 19%, RC wall of water absorption of 5% and 16.5% outside the wall of water absorption. For future buildings significantly reduce the probability of an indoor leak outside, and can reduce the incidence of the wall of water seepage. Compressive strength, the study of lightweight concrete brick compressive strength of 107 Kgf/cm<sup>2</sup>, compared with other compartments of building materials, brick compressive strength of 100 Kgf/cm<sup>2</sup>, sand gray bricks compressive strength of 90 Kgf/cm<sup>2</sup>, and therefore the light of this study quality concrete used as interior partitions materials is quite appropriate. Optimal production parameters are shown in Table 5

Table 5 Optimal Production Parameters Lightweight Bricks Composite Formulation

Formulation	Additive	Carbon ash proportion	Cement mortar Type
Type	M3824	Ash40	CM2
Explanation		C: under 10%	Cement: Portland cement Type I
	Resin: Acrylic Series Solvent: soft water Solid content: than 45% Operating temperature: room temperature	Cl : Not Detected As: Not Detected Fe: under 0.1%	Sand: under 16mesh Water: soft water

## 7 Conclusions

The waste mixed plastic carbon ash cannot be re-used as industrial raw materials, the use of waste mixed plastic carbon ash severely limited. In addition, research scholars and experts in the past pointed out that although waste mixed plastic carbon ash having a large surface area, but the composition contains a large amount of ash and volatile organic substances. In this study, that the waste has a new use of carbon ash. The carbon ash used in the production of lightweight concrete building materials. After extrusion, a Lightweight brick was made by carbon ash, additive and Cement mortar. In general, the density and water absorption effect of lightweight bricks with M3824 additive for significant impact. The water absorption and thermal conductivity effect of lightweight bricks with Ash40 carbon ash proportion for

significant impact. The density and compressive strength effect of lightweight bricks with CM2 cement mortar for significant impact.

Therefore, under conditions of technology and economic, the results of this study as reference for market-oriented marketing and commercialization of production.

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