Academic Journal of Architecture and Civil Engineering
ISSN: 2960-0243
DOI: 10.61784/ajacev2n203

DISCUSSION ON THE REUSE OF WASTEWATER FROM CONCRETE MIXING STATIONS FOR CONCRETE PRODUCTION

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Abstract: With the rapid development of China's construction industry, the development of ready-mixed concrete is also increasing. More and more concrete mixing stations have been established in major and medium-sized cities, promoting the development of commercial concrete. However, concrete mixing stations discharge a large amount of wastewater, which not only pollutes the environment but also wastes water resources. It does not meet the requirements of green environmental protection. However, reasonable and effective utilization has always been a technical problem. To this end, this article mainly studies the effective use of wastewater and waste residue discharged from concrete mixing stations in concrete.
Keywords: Concrete, Mixing station, Wastewater, Utilization

1 INTRODUCTION

When flushing concrete mixer trucks, pump trucks and mixers, a large amount of sewage will be formed. According to relevant statistics, a concrete company with an annual production capacity of 200,000 cubic meters can produce up to 30m3 of wastewater every day[1]. At the same time, this wastewater is not only highly alkaline, and direct discharge will cause alkalinization of the soil and contamination of water resources, but it is also mixed with sand, stone, and incompletely hydrated cementitious materials. If not treated, it will be a waste of resources. It will also block various municipal facilities and pollute rivers, all of which seriously endanger the social environment. In JGJ/T 328-2014 "Ready-mixed Concrete Green Production and Management Technology", "wastewater treatment system" and "wastewater utilization" are included in the green production star rating[2]. In response to these situations, it is necessary to process and recycle this wastewater and replace it with concrete production water. On the basis of ensuring the quality of concrete, it can also purify the environmental sanitation of the mixing station, protect the ecological environment, save water resources, and bring certain economic benefits. Realize "zero discharge" of waste water and waste residue[3].

2 BASIC PROPERTIES OF WASTEWATER DISCHARGED FROM CONCRETE MIXING STATIONS

After the mixing station produces concrete, tap water is generally used to flush the mixing equipment and wash the mixer trucks. The wastewater generated not only contains incompletely hydrated cement, unhydrated admixtures, clay, fine sand and other granular solids, and also contains many hydrated ions, such as Ca^{2+}, OH^-, etc. To a certain extent, the solid content is determined by the flushing volume and treatment facilities, the ion concentration is affected by the concrete design ratio, and the wastewater properties are affected by residual admixtures[4]. When testing wastewater, the test indicators are mainly solid content. Relevant research shows that the solid content of wastewater has nothing to do with its pH. When the storage time is extended, various wastewater particles will continue to hydrate and change the ion concentration[5].

3 CURRENT SITUATION

At present, in most wastewater treatment systems of mixing stations, sand and gravel are filtered through sand and gravel separation equipment, and the wastewater is then separated and precipitated. When wastewater is precipitated, it often passes through multiple sedimentation tanks[6]. After the solid particles in the wastewater are precipitated multiple times, a more ideal precipitation effect can be obtained. However, it occupies a large area, and wastewater and waste residue are not utilized, which does not meet the requirements of green environmental protection.
Our station filters through sand and gravel separation equipment to separate sand and gravel for recycling and reuse. The wastewater is directly discharged into the mixing tank (two interconnected hexagonal tanks with a diameter of 3.5m and a depth of 4.0m and equipped with stirring blades) and is stored for later use.

4 TEST ON THE INFLUENCE OF CLEAN WATER AND WASTEWATER ON THE PERFORMANCE AND STRENGTH OF CONCRETE

Raw materials:
(1) Cement: Tower brand P.O42.5R cement, 28-day compressive strength is 50.2MPa. (2) Machine-made sand: medium sand, fineness modulus 2.7, powder content 4.6%.
(3) Gravel: 5mm~31.5mm particle size, continuously graded.
(4) Mineral powder: Fujian Sanming Mineral Powder, S95.

(5) Admixture: finely ground limestone powder, 0.045mm sieve residue <15%.
(6) Clean water: tap water.
(7) Wastewater: wastewater with a solid content of 10%.
(8) Water-reducing agent: Huaxinda high-efficiency water-reducing agent, with a water-reducing rate of 26%.

Table 1 Comparison of clean water and wastewater test data

	clear water		wastewater	
Strength level (pump feed)	C30	C50	C30	C50
Additive content (%)	1.6	1.9	1.8	2.2
Workability	generally	generally	good	good
Initial slump/expansionmm	200/500	210/520	200/500	205/510
Slump/expansion mm in 1 hour	200/490	210/530	200/500	210/510
1.5 hour slump/expansion mm	190/465	190/480	180/460	180/450
Initial setting time (min)	240	225	225	220
Final setting time (min)	485	430	480	420
7-day strength (MPa)	23.8	46.2	24.0	46.0
28-day strength (MPa)	33.6	57.6	33.1	57.2

It can be seen from Table 1 that when wastewater with a solid content of 10% is used as mixing water, although the amount of admixtures increases (the solid content of the wastewater contains incompletely hydrated cement, unhydrated admixtures, clay , fine sand and other granular solids, which will absorb admixtures), but can improve the workability of concrete and have little effect on slump and slump loss, setting time and strength, and can be used completely.

Table 2 Concrete mix ratio (kg/m3)

	cement	Mineral powder	admixture	Machine-made sand	1-3 gravel	water	Plus agent
C30	230	50	50	810	1064	160	6.0
C50	400	100	0	602	1157	140	11.0

Table 3 Effect on carbonization performance of building components (all pumped materials, wall columns, 28-35 days old)

	clear water	wastewater	Remark
C20	1.5mm	2.0mm	
C25	1.5mm	1.5mm	
C35	1.0mm	1.0mm	
C50	0.0mm	0.0mm	

It can be seen from Table 3 that the carbonation coefficients of concrete components stirred with clean water and wastewater are almost the same, and are considered to have no effect.

5 SPECIFIC PRACTICES IN USE

(1) After the sand and stone are separated, the wastewater is directly discharged into the hexagonal mixing tank for mixing,

(2) Keep the water level in the mixing hexagonal tank within a certain range. When the production volume is large and the wastewater is insufficient, use clean water to supplement it, that is, control the relatively stable solid content, (3) Install an automatic stirring device in the mixing hexagonal tank (Stir for 5 minutes and stop for 90 minutes. If there is no production, stir according to the set program), (4) Cancel the original clean water intermediate bin and directly extract wastewater to the scale for measurement to prevent sedimentation and material formation at the bottom of the intermediate water bin, (5) Open every day The solid content is measured before production and every 2 hours during production, so that the concrete mix ratio can be adjusted in time to ensure the quality of the factory concrete.

6 DISCUSSION

(1) When using wastewater with a solid content of 10% as mixing water, the amount of admixture should be increased by approximately 0.2% to 0.3%. (2) The workability of concrete becomes better, and the sand rate can be appropriately reduced by about 1%. (3) It has little effect on slump, slump loss, setting time and strength. (4) Further tests are required on the carbonization performance and durability of concrete components. (5) Since the mixing tank realizes continuous automatic control of mixing, the placement time of wastewater has little impact on the performance of concrete.

7 CONCLUSION

Through the wastewater recycling system, the concrete mixing station can recover wastewater in concrete preparation for recycling. By using a sand and stone separation system with a simple overall structure and easy installation and use, and a hexagonal mixing tank with an automatic mixing device, the solid content of the wastewater can be controlled relatively stably, and the wastewater from the mixing station can be recycled and used to achieve zero discharge of wastewater and waste residue. This not only It avoids waste of resources, reduces the actual production cost of the concrete mixing station, and reduces the problem of large sedimentation tanks and large floor space, meeting the requirements of a green and environmentally friendly mixing station.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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