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Materials Today: Proceedings 5 (2018) 1607–1614

materialstoday: PROCEEDINGS

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PMME 2016

Feasibility of wastewater as mixing water in cement

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Abstract

This paper presents the feasibility of wastewater from small scale water treatment plants located in residential buildings as mixing water in Ordinary Portland Cement (OPC). Fourteen water treatment plants were found out in the Narasaraopet municipality region in Guntur district, Andhra Pradesh, India. Approximately, from each plant, between 3500 and 4000 L/day of potable water is selling to consumers. All plants are extracting ground water and treating through Reverse Osmosis (RO) process. During water treatment, plants are discharging approximately 1,00,000 L/day as wastewater in side drains in Narasaraopet municipality. Physical and chemical analysis was carried out on fourteen plants wastewater and distilled water as per [1]. In the present work, based on the concentrations of constituent's in wastewater, four typical plants i.e., Narasaraopeta Engineering College (NECWW), PatanKhasim Charitable Trust (PKTWW), MahmadhKhasim Charitable Trust (MKTWW) and Amara (ARWW) were considered. The performance of four plants wastewater on physical properties i.e., setting times, compressive strength, and flexural strength of Ordinary Portland Cement (OPC) were performed in laboratories and compared same with reference specimens i.e., made with Distilled Water (DW) as mixing water. No significant change was observed in initial setting time but significant change was observed in finial setting time. No significant change was observed in 90 days compressive strengths in four plants wastewater compared to that of reference specimens. XRD technique was employed to find out main hydration compounds formed in the process.

Selection and Peer-review under responsibility of International Conference on Processing of Materials, Minerals and Energy (July 29th – 30th) 2016, Ongole, Andhra Pradesh, India.

Keywords:Wastewater, cement, setting time, compressive strength, flexural strength

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1. Introduction

Ever since concrete began to be used as a construction material, potable water has been using as the mixing water in concrete due to the chemical composition is well known. The literature search indicates that, not much research work has carried out on the quality of mixing water in concrete and there are no detailed guide lines in[2 - 4]for the use of water in concrete. The building code requirements of different countries generally contain broad guidelines on mixing and curing water. Most of the codes consider potable water to be satisfactory for both mixing and curing of concrete and stipulate permissible limits for solids and aggressive chemicals. .However, In recent years, attention has been focused on the potential for various aspects of wastewater reuse, although previous research has been performed on the use of wastewater that are producing from the water treatment plants and industries for making concrete and reported that no adverse effects on concrete properties in fresh and hardened state [5-17].Also in [2,18] stated that the compressive strength of the cubes made of water with unknown chemical composition not to be less than 90% of cubes made with potable water. There is a note in BS 3148 – 1980whichstates that non potable water that results in a strength reduction of up to 20% can be acceptable compared to that of cubes made with potable water, but the mixture proportions should be adjusted appropriately. However, limit of a chemical in mixing water of concrete given by various codes is tabulated in table .1

Therefore, throughout India, several unregistered small scale water treatment plants might have setup as a result huge volume of wastewater is generating. Hence, the aim of this work was to study the feasibility of wastewater from small scale water treatment plants located in residential buildings as mixing water in cement.

2. Materials And Methods

2.1. Cement

53- Grade ordinary Portland cement was used. The physical properties of cement are given in Table: 2.

2.2 Sand

The ennor sand was used. Table 3 gives its physical properties. The cement to fine aggregate ratio was maintained at 1:3 by weight in the mortar mixes.

2.3 Water

Distilled water was used in reference specimens and wastewater from typical four water treatment plants were used in test specimens. The physical and chemical properties of distilled and fourteen plants wastewater are given in Table: 4.

Table:1 Tolerable limits of impurities in mixing water of concrete (all values in mg/L, except pH)

Constituent	Tolerable Limit	Reference
pH	3	[19,20]
	>5	[21,22]
	6	[2]
	6-8	[23]
	7-9	[3]
Total solids	50000	[4]
	5000-10000	[24]
	4000	[20]
Suspended solids	2000	[24,25,2]
Dissolved solids	50000	[27]
	2000	[25,2,3]
	<6000	[28]
Organic solids	200	[2]
Inorganic solids	3000	[2]
Total Alkalinity(as $CaCO_3$)	500	[3]
	1000	[29,26]
Sodium Carbonates and Bicarbonates	2000	[21,22,24]
Carbonate	1000	[26]
Bicarbonate	400	[26]
Chlorides for plain concrete	360	[33]
	500	[21,22,25]
	2000	[2]
	4500	[34]
Chlorides for Reinforced concrete	500	[9,2,35]
	1000	[36, 34]