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DESALINATION OF SEAWATER AND DEDUCTION OF CORROSION

Mrs. S.Theerkadharshini*[1], V.Paari Chackravarthy*[2], M.Ram kumar*[3],
R.Arun raj*[4] ,K.Muthu prince*[5]

Asst.Professor, Dept. of Civil , Panimalar Engg. College, India*[1].
Student, Dept.of Civil, Panimalar Engg. College, India*[2*3*4*5]

ABSTRACT— *Today currently employ reverse osmosis (RO) as the method of desalinating water for use as potable water on sea vessels. RO desalination is very effective; however, it is subject to scaling and fouling, which reduces the lifespan of the membrane and increases cost. The current pretreatment system for the RO is cartridge filtration. The proposed system consists of a dual media filter, filled with granular activated carbon (GAC). The media filter is followed by a 20 µm cartridge filter. Backwashing of the media filter is automated, and the water is diverted to the second filter, ensuring continuous treatment. The cartridges only require replacement once per 45 days, thus significantly reducing the needed storage area and off-line time. Dual media filtration reduces the turbidity, while cartridge filtration and GAC decrease the concentration of organic carbon. This combination satisfies the treatment system objectives. The RO pretreatment system is designed to produce quality water.An experimental investigation is carried out on a concrete containing for M-20 grade concrete(RCC). Beam is casted using normal bore water and the desalinated water. Material was produced, tested and compared with conventional concrete in terms of workability and strength. These tests were carried out on standard beam of 700*150*150 mm for 7 and 14 days to determine the mechanical properties of concrete corrosion and flexural strength .It was cured for 14 days and then soaked in sulphuric acid for 24 hours. After this process, the beam was tested for its corrosion and desalinated sea water found to have percentage of corrosion more than the percentage of corrosion noticed in beam made using ordinary bore water*

Keywords: Reverse osmosis, Membrane, Granular activated carbon, Turbidity, workability, Concrete, Corrosion test

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1. INTRODUCTION

Desalination/distillation is one of mankind's earliest forms of water treatment, and it is still a popular treatment solution throughout the world today. In ancient times, many civilizations used this process on their ships to convert sea water into drinking water. Today, desalination plants are used to convert sea water to drinking water on ships and in many arid regions of the world, and to treat water in other areas that is fouled by natural and unnatural contaminants. Distillation is perhaps the one water treatment technology that most completely reduces the widest range of drinking water contaminants.

In nature, this basic process is responsible for the water (hydrologic) cycle. The sun supplies energy that causes water to evaporate from surface sources such as lakes, oceans, and streams. The water vapor eventually comes in contact with cooler air, where it re-condenses to form dew or rain. This process can be imitated artificially and more rapidly than in nature, using alternative sources of heating and cooling.

The low-tech approach to accomplish this is to construct a "solar still" which uses heat from the sun to run a distillation process to cause dew to form on something like plastic sheeting. The diagram to the right illustrates this. Using seawater or plant material in the body of the distiller creates humid air, which, because of the enclosure created by the plastic sheet, is warmed by the sun. The humid air condenses water droplets on the underside of the plastic sheet, and because of surface tension, the water drops stick to the sheet and move downward into a trough, from which it can be consumed.

2. METHODS OF DESALINATION

Osmosis:

There are two methods of desalination by osmosis that are used- reverse and forward osmosis.

Reverse osmosis:

Pressure is applied to push water through a semi-permeable membrane. The membrane is designed to prevent larger solutes from passing through.

Problems: It requires a lot of energy and is expensive. The membranes become clogged with bacteria and they deteriorate when chlorine is used to kill the bacteria.

Forward osmosis:

A semi-permeable membrane separates the saline water from a highly concentrated solution of ammonia salts. Water molecules move across the membrane into the highly concentrated solution. The ammonia solution is heated to evaporate the ammonia salts which are collected and reused. This is a relatively new technology and needs funding for further research and development.

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Thermal process:

The thermal desalination process uses energy to evaporate water and subsequently condense it again. When there is waste heat or sufficient electricity available, as is often the case with refineries and power plants, thermal desalination is an efficient and viable solution.

3.COMPONENTS AND DESCRIPTION

The main components of this project are,

- Pre carbon filter
- Ro purifier
- 24volt DC motor
- Battery

3.1 PRE CARBON FILTER:

Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption.Each particle/granule of carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media. One pound (450 g) of activated carbon contains a surface area of approximately 100 acres (40 Hectares).

Activated carbon works via a process called adsorption, whereby pollutant molecules in the fluid to be treated are trapped inside the pore structure of the carbon substrate. Carbon filtering is commonly used for water purification, in air purifiers and industrial gas processing, for example the removal of siloxanes and hydrogen sulfide from biogas. It is also used in a number of other applications, including respirator masks, the purification of sugarcane and in the recovery of precious metals, especially gold. It is also used in cigarette filters.

Active charcoal carbon filters are most effective at removing chlorine, sediment, volatile organic compounds(VOCs), taste and odor from water. They are not effective at removing minerals, salts, and dissolved inorganic compounds.

Typical particle sizes that can be removed by carbon filters range from 0.5 to 50 micrometres. The particle size will be used as part of the filter description. The efficacy of a carbon filter is also based upon the flow rate regulation. When the water is allowed to flow through the filter at a slower rate, the contaminants are exposed to the filter media for a longer amount of time.

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3.2 REVERSE OSMOSIS(RO) FILTER:

Reverse osmosis (**RO**) is a water purification technology that uses a semipermeable membrane to remove ions, molecules, and larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure, a colligative property, that is driven by chemical potential differences of the solvent, a thermodynamic parameter.

Reverse osmosis can remove many types of dissolved and suspended species from water, including bacteria, and is used in both industrial processes and the production of potable water. The result is that the solute is retained on the pressurized side of the membrane and the pure solvent is allowed to pass to the other side. To be "selective", this membrane should not allow large molecules or ions through the pores (holes), but should allow smaller components of the solution (such as solvent molecules) to pass freely.

In the normal osmosis process, the solvent naturally moves from an area of low solute concentration (high water potential), through a membrane, to an area of high solute concentration (low water potential). The driving force for the movement of the solvent is the reduction in the free energy of the system when the difference in solvent concentration on either side of a membrane is reduced, generating osmotic pressure due to the solvent moving into the more concentrated solution. Applying an external pressure to reverse the natural flow of pure solvent, thus, is reverse osmosis.

The process is similar to other membrane technology applications. However, key differences are found between reverse osmosis and filtration. The predominant removal mechanism in membrane filtration is straining, or size exclusion, so the process can theoretically achieve perfect efficiency regardless of parameters such as the solution's pressure and concentration. Reverse osmosis also involves diffusion, making the process dependent on pressure, flow rate, and other conditions. Reverse osmosis is most commonly known for its use in drinking water purification from seawater, removing the salt and other effluent materials from the water molecules.

The methods used include physical processes such as filtration, sedimentation, and distillation; biological processes such as slow sand filters or biologically active carbon; chemical processes such as flocculation and chlorination and the use of electromagnetic radiation such as ultraviolet light.

Purifying water may reduce the concentration of particulate matter including suspended particles, parasites,bacteria, algae, viruses, fungi, as well as reducing the amount of a range of dissolved and particulate material derived from the surfaces that come from runoff due to rain.

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3.3 MOTOR:

A **DC motor** is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current flow in part of the motor. Most types produce rotary motion; a linear motor directly produces force and motion in a straight line.

DC motors were the first type widely used, since they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight motor used for portable power tools and appliances

4. WORKING PRINCIPLE

In our project, the water is purified by using two filters such us pre carbon filter, RO filter. Desalination of salt water into drinking water is done by the process.

Inlet is connected to the pre carbon filter the water is sucked through the inlet pipe, then he inlet is connected to the 24v dc motor. Between the pre carbon filter and battery Ro filter is assembled.

Water is sucked as input through the pre carbon filter and it is passed to the 24v motor or pump which is the input of pump or motor and the outlet of precarbon filter. Outlet of motor or pump is connected to the input of RO filter. RO filter consists of two outputs (ie) one is salt water and the another one is purified water. In the outlet of salt water from RO is connected with small filter and the another pipe releases the pure water.

5. PROPERTIES OF MATERIAL USED

Physical Properties of cement

Portland cements are commonly characterized by their physical properties for quality control purposes. Their physical properties can be used to classify and compare Portland cements. The challenge in physical property characterization is to develop physical tests that can satisfactorily characterize key parameters.

- Setting Time
- Soundness

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- Fineness
- Strength

Setting time

- Cement paste setting time is affected by a number of items including: cement fineness, water-cement ratio, chemical content (especially gypsum content) and admixtures.
- Setting tests are used to characterize how a particular cement paste sets.

Soundness

- When referring to Portland cement, "soundness" refers to the ability of a hardened cement paste to retain its volume after setting without delayed expansion.This expansion is caused by excessive amounts of free lime (CaO) or magnesia (MgO). Most Portland cement specifications limit magnesia content and expansion.
- The cement paste should not undergo large changes in volume after it has set.However, when excessive amounts of free CaO or MgO are present in the cement, these oxides can slowly hydrate and cause expansion of the hardened cement paste.
- Soundness is defined as the volume stability of the cement paste.

Fineness

- Fineness, or particle size of Portland cement affects Hydration rate and thus the rate of strength gain.The smaller the particle size, the greater the surface area-to-volume ratio, and thus, the more area available for water-cement interaction per unit volume.
- The effects of greater fineness on strength are generally seen during the first seven days.
- When the cement particles are coarser, hydration starts on the surface of the particles

Aggregate

Locally available river sand of specific gravity 2.64, fineness modulus 2.91, and conforming to Zone II was used as fine aggregate. The crushed granite stone with a maximum size of 12 mm, and specific gravity 2.65 was used as coarse aggregate. Both fine aggregate and coarse aggregate used conform to IS: 383-1970.

Fine aggregate

The material which passes through BIS test sieve number 4 (4.75mm) is termed as fine aggregate usually natural sand is used as a fine aggregate at places where natural sand is not available crushed stone

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is used as fine aggregates. In our region fine aggregate can be found from bed of Krishna River. It conforms to IS 383 1970 comes under zone II.

Coarse aggregate

The material which is retained on BIS test sieve number 4 (4.75mm) is termed as coarse aggregate. The broken stone is generally used as a stone aggregate. Coarse aggregate used is locally available crushed angular aggregate of size 20mm and 10mm are used for this experimental work.

6. PROCEDURE

6.1 Batching

It is the process of measuring concrete mix ingredients either by volume or by mass and introducing them into the mixture. Traditionally batching is done by volume but most specifications require that batching be done by mass rather than volume. Percentage of accuracy for measurement of concrete materials is as follows:

Cement:

When the quantity of cement to be batched exceeds 30% of scale capacity, the measuring accuracy should be within 1% of required mass. If measuring quantity is less than 30% i.e. for smaller batches then the measuring accuracy should be within 4% of the required quantity. Than 30% then the measuring accuracy should be within less than 3%.

Aggregates:

If the measurement is more than 30% of the scale capacity then the measuring accuracy should be within 1%. If measurement is less 3%.

6.2 Mixing

It is the process of measuring concrete mix ingredients either by volume or by mass and introducing them into the mixture. Traditionally batching is done by volume but most specifications require that batching be done by mass rather than volume. Percentage of accuracy for measurement of concrete materials is as follows: Concrete is basically a mixture of two components:

- Paste
- Aggregates

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The paste, usually comprised of Portland cement and water, binds the aggregates (sand and gravel or crushed stone) into a rocklike mass as the Paste hardness because of the chemical reaction of the cement and water.

6.3 Casting

Casting is a manufacturing process in which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various cold setting materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods.

7. CORROSION MECHANISM AND RESULTS

A standard beam of 0.7m*0.15m*0.15m was prepared with a concrete made using ordinary bore water and desalinated sea water. It was cured for 14 days and then soaked in sulphuric acid of 1.5N for 24 hours .The beam is dissolved in sulphuric acid .After that the final weight is calculated .That is done for both bemas.After this process, the beam was tested for its corrosion and desalinated sea water found to have percentage of corrosion more than the percentage of corrosion noticed in beam made using ordinary bore water

FORMULAE:

$$\text{Corrosion} = M1\text{-}M2/M1 * 100$$

8. CONCLUSION

From this, it is found that various methods are developed for distillation of water. These methods are subject to the demand of fresh water, quality of water source and the involved expense. Conventional Reverse Osmosis systems are currently prevalent domestically but at the cost of plenty of waste water. Sea water is purified by using RO and Pre carbon filter. The beam is casted using normal bore water and the purified sea water. Then, the beam is immersed in sulphuric acid of 1.5N for 14days and the corrosion is determined.

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