

Water Re-Circulating Washing Machine

Vishnudas.K.P¹, Vishnu Prasad.K.R², Vishnu Vijayan.K³, Vishnu Pradeep.P⁴, Raisen Joy⁵(AP-ME)

Department of Mechanical Engineering, A.P.J Abdul Kalam Technological University, Trivandrum, Kerala, India

Royal College of Engineering and Technology, Akkikavu, Thrissur, Kerala, India

ABSTRACT: Reverse osmosis is a water purification technology that uses a partially permeable membrane to remove many types of dissolved and suspended chemical species as well as biological ones from water. Applying an external pressure to reverse the natural flow of pure solvent, thus, is reverse osmosis. Here we use the principle of reverse osmosis to purify the water containing detergent particles and other foreign objects after the washing of cloths in a washing machine. Then this purified water is stored and re-circulated to washing machine for next wash. This set up can reduce the total quantity of water used for washing purpose, and we can conserve the water for next generation by saving it. If we are a consumer of water authority and using pipe line water for the household purposes, the cost for water per month is conveniently reduced especially in washing purposed by water re-circulating washing machine.

I. INTRODUCTION

^[1]Water is a common chemical substance essential for the survival of almost all known living organisms. Water covers 71% of the earth's surface, but 97% of this water exists as salt water in oceans. Of all surface water, glaciers and icecaps hold approximately 2%, and freshwater rivers and lakes contain only 1%. Yet many societies around the world do not give consideration and attention to preserving this vital commodity that is in limited supply. It is estimated that in 2020, at the current rate, 75 million people will die each year of preventable water related deaths. In the case of each person we use a huge amount of good water for the cleaning purpose. One of them is the washing purpose. We use certain quantity of water for washing in each single day Here we are going to discuss how this polluted detergent water after washing can be purified and re-circulated. Here we use the principle of reverse osmosis to purify the water containing detergent particles and other foreign objects after the washing of cloths in a washing machine. While this set up reduces the total quantity of water used for washing purpose, and we can conserve the water for next generation by saving it.

A. Background

A water re-circulating washing machine is device that purifies and re- circulates water by reverse osmosis as working principle. The detergent water from the washing machine is allowed to pass through a semi-permeable membrane with sufficient pressure, after purification pure water get collected and reused.

B. Motivation

WRWM which is easily affordable by middle class and reduce the overall consumption of water for washing purpose. In this concept the RO technique is used to improve the purification process. So in our project, we made acknowledge these factors about a cost effective water management system.

C. Problem Identification

Water consumption is increasing day by day, so conserving it is our duty. In this project we reduce the consumption of water using RO technique by installing it on washing machine where we have a greater amount of water loss.

D. Objectives

The objective of this project is to reduce overall consumption of water and also to maintain effective water management. This has the advantage of minimum water consumption with efficient technology and purified water can be consumed for other purposes.

E. Scope

The current study focuses on implementation of water re-circulating washing machine for domestic washing purposes. Such a system with low cost and high efficiency is tested. The existing washing machine demands large consumption of water but our product demands comparatively moderate water usage.

III. DESIGN & COMPONENTS

a. Design of Water re-circulating Washing machine

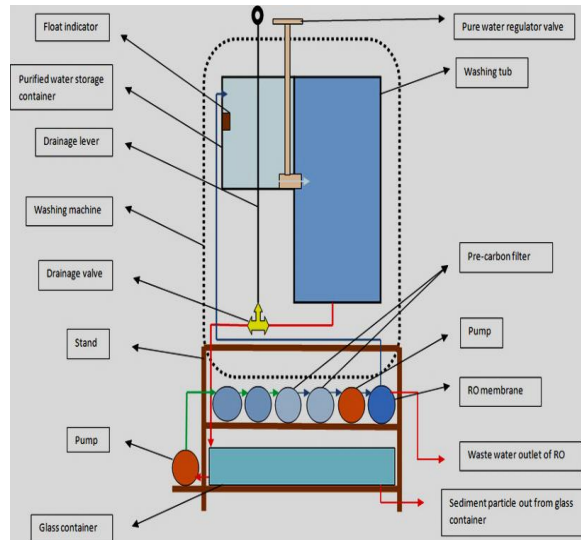


Fig. 1 Design of water re-circulating washing machine

b. Components & Discription

i. Spun filter

Usually, the inlet water supply enters the RO system via the prefilter. Depending on the quality and the TSD of inlet water, some units use a series of prefilters to remove particles as well as oxidative components, such as chlorine, that potentially damage RO membranes. The most commonly used prefilters are sediment filters (multi-media filters) used to remove sand, silt, dirt, particulate and other sediment material. Charcoal filters are used to remove oxidizing compounds, such as chlorine, to protect the membranes, particularly thin film composite (TFC) and thin film material (TFM) membranes. Carbon prefilters are not routinely use when the system uses cellulose tri-acetate (CTA) membranes, but most companies use the TFC/TFM filter.



Fig. 2 Spun filter

ii. Sediment filter

Using a step by step filtering per stone. This filter effectively eliminates various foreign bodies that come from the various water pipe such as bits and also protect the RO membrane. This filter has non woven fabric roll which act as protector.



Fig. 3 Sediment filter

iii. *Carbon cartridge*

It is used to remove certain chemical and organic chemical component in the water. It also removes dissolved dirt in the water. An active carbon filter is used for it. Also, String-wound polypropylene filters used to remove particles of 1 to 5 μm diameter.



Fig. 4 Carbon cartridge filter

iv. *Semi permeable membrane*

Reverse osmosis is done through the membrane. The impurities are get trapped on one side of the membrane while the pure solvent passes the membrane. It has two outlets one is fresh water outlet and the other is waste water outlet.

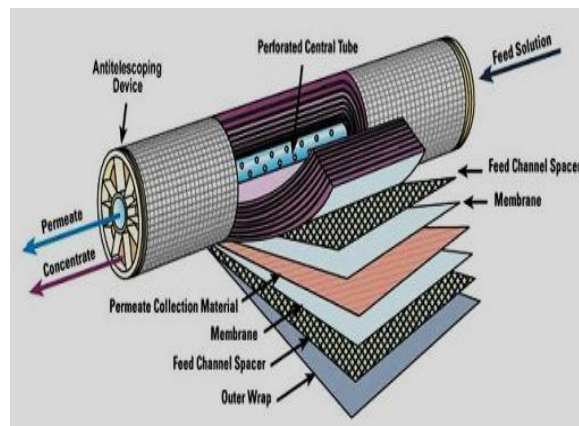


Fig. 5 Semi permeable membrane

v. *High pressur pump*

High-pressure pumps and control valves that regulate the flow-through system and generate filtration pressure for reverse osmosis. Pumps operate by some mechanis (typically reciprocating or rotary) and consume energy to perform mechanical work moving the fluid. Pumps operate via many energy sources, including manual operation, electricity, engines, or wind power, come in many sizes, from microscopic for use in medical applications to large industrial pumps.



Fig. 6 Pump

TABLE 1
SPECIFICATIONS OF PUMP

Specifications		
1	Company	Pentair
2	Model	8015-P 100
3	Volts	24VDC
4	Amps	0.25
5	Open flow	0.5 GPM / 1.89 LPM
6	Pressure setting	By-Pass

vi. *Storage tank*

To store detergent water from the washing machine and also store the purified water from the semi-permeable membrane.

vii. *Switch mode power supply*

A switched mode power supply is an electronic power supply that incorporates a switching regulator to convert electric power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as personal computer, while converting voltage and current characteristics.

viii. *Washing machine*

The washing machine used is Onida’s hydro shakti. Which is a double door washing machine, one is washing tub and the other is a spinner having a capacity of 58 liters.

ix. *Flow rejector*

The flow rejector, as the name suggests, restricts the flow of waste water in the drain leaving the membrane. It provides resistance, creating pressure against the membrane and forcing some water, permeate, or product water, through the membrane.



Fig. 7 Flow rejector

x. *Float indicator*

The float valve has one major function and that is to stop the flow of water from an inlet supply line. The float valve rises as the water level rises. Once a specified water level is reached, this will cause the one-way valve to be activated and shut off the water entry.



Fig. 8 Float indicator

IV. CONSTRUCTION & WORKING

^[2]The RO is somewhat similar to other membrane technology applications, such as ultra-filtration, but there are differences between RO and other filtration. The removal mechanism in filtration is straining or size exclusion, and pore sizes are larger than with RO membranes. The ultra-filtration process at least in theory, provide good exclusion of particles, regardless of the

operational variability, including pressure and solute concentrations. However, because the pore sizes are larger, inorganic components, all heavy metals, and microbial agents pass through the ultra-filtration process. The detergent water from the washing machine outlet is initially stored in a storage tank, from there it is allowed to pass through a spun filter for the first stage filtration. The spun filter remove the solid contaminants like threads, dirt particles and objects which are larger. After first stage filtration the water is entered into a carbon cartridge for the inter-mediate filtration process. In the carbon cartridge it removes certain chemicals & organic chemicals contained in the water. The water from the cartridge outlet is pressurized and transported to semi-permeable membrane by a pump. Semi-permeable membrane remove the iron, nitrates, ion elements and other micro particles in the water. For this the reverse osmosis technology is used.

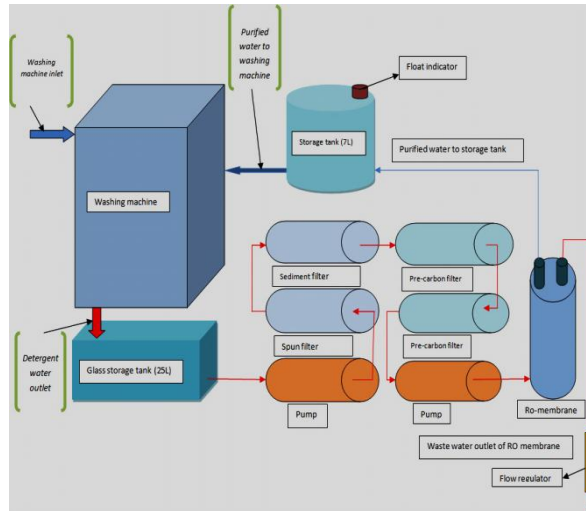


Fig. 9 Flow diagram of WRWM

When the pressurized water passes through the semi-permeable membrane the contaminants remains the pressurized region and the pure water passes the membrane. The pure water is taken from one outlet and the waste water from the other. The pure water is stored and re-circulated.

V. POWER SUPPLY IN WRWM

From the main supply one out is taken to washing machine and the other one is taken to power the pumps in purification set up. The pumps used are DC pump; hence the AC current from main out should be converted to DC, a pair of SMPS used for this. Both pumps are connected to each one of SMPS, which is in a manner that, positive terminal of each SMPS is connected to positive of each pump. But the negative terminal of SMPS is initially connected to one end of float indicator, and the negative terminal of pumps is connected to the other end of float indicator to complete the circuit.

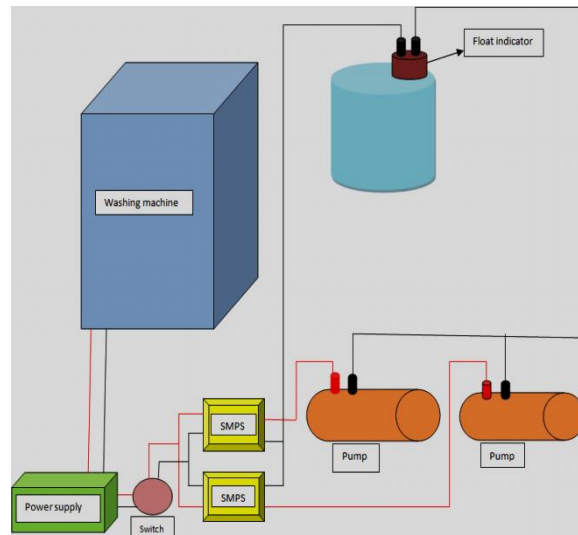


Fig. 10 Power supply diagram

This kind of connection used to stop the working of the pump when sufficient amount of water is filled inside the purified water storage tank. Since the float indicator acts like a switch, cutoff the power to pump when the tank is filled with required quantity of water.

TABLE 2
COMPARISON BETWEEN NORMAL & WATER RECIRCULATING WASHING MACHINE

Normal washing machine	Water recirculating washing machine
Detergent water after washing is directly drained	Drained detergent water is collected & recirculated
Same quantity of water is used for next wash	Small quantity of make up water used with recirculated water
Water consumption is comparatively high	Water consumption is comparatively low
Cost of water is same for each wash	Cost of water is reduced in each wash
Uncontrolled use of water	Controlled use & saving of water

VI. RESULT & OBSERVATIONS

Result obtained after the process is very satisfying. Detergent water is fully purified into drinkable water with a TDS value of 20 ppm.

TABLE 3
OBSERVATIONS

Total quantity of water used	15 Litre
TDS value of detergent water	1020 ppm
TDS value of recirculated water	20 ppm
Quantity of recirculated water	7 Litre

TABLE 4
TDS VALUE PER GRAM OF DETERGENT

Detergent value (Gram)	TDS value (ppm)
5	290
10	350
15	415
20	480
25	553
30	623
35	680
40	730
45	800



50	870
55	950
60	1020

VII. CONCLUSIONS

A combined version of washing system and a purification system in an efficient and low cost manner with minimum moving parts. In this we used approximately 15L water. To this we added around 390grams of detergent powder. The allowable TDS value of our RO membrane is approximately 1500ppm. Thus, by filtration using RO technology the water is filtered out and the new TDS value of purified water is 20ppm which is safe and useful to us. Whereas the TDS value of waste water from RO membrane is 1378ppm and it will be rejected out.

Here we used 15L of water, of this 7L of purified water is available for washing purpose within 1 hour.

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