

# Development of RO water purifier with digital TDS meter

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## Abstract:

Reverse osmosis (RO) is a water purification technology which uses a semi permeable membrane to remove ions, salts, organics, bacteria and larger particles from drinking water. In reverse osmosis, an applied pressure is used to overcome osmotic pressure. It is a colligative property, that is driven by chemical potential differences of the solvent. Basically, it demineralizes or deionizes water by pushing it under pressure through a semi permeable reverse osmosis membrane. We have RO water purifier including UV and UF. This paper discusses the development of RO water purifier with attached TDS meter indicator which can be used in further treatment of water for potable and industry purposes.

## Keywords:

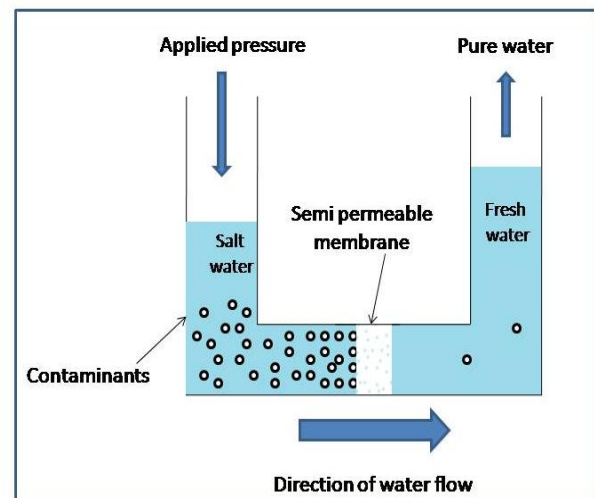
Reverse Osmosis, Ultraviolet, Ultra Filtration, Total dissolved solids.

## 1. Introduction:

In most parts of the world the fresh water resources are available but many of these resources are getting contaminated with human as well as natural activities. To increase the production in agriculture various herbetics, pesticides for pest control, fertilizers, and fungicides are used. The use of such artificial chemical is degrading the quality of fresh water resources, ground water adversely. Water purification is the process of removal of undesirable chemicals, biological contaminants, suspended solids and gases from water. If someone used to drink water or impure water without purification, then he or she may suffer from various health problems such as diarrhea,

vomiting, nausea, typhoid, fever and more. The history of water filters can be traced to the earliest civilizations. Water filters have been used throughout history to improve the safety and aesthetics of water intended to use for drinking. Nowadays, they are also widely used in industry and commerce. The history of water filtration is closely linked with the broader history of improvements in public health. Documentation of water treatment tells that in 2000BC, where water was boiled and strained to clean it. The first domestic filter to be made was by the Greek scientist Hippocrates, called the Hippocratic sleeve around 500BC. This was a simple cloth back filter.[3]

### 1.1 How reverse osmosis works



Reverse Osmosis (RO) is a process that uses semi-permeable membranes to separate and remove dissolved solids, organic, colloidal matter, nitrate and bacteria from water. We get Feed water through the semi- permeable

membrane, where water then passes through the pores of the membrane and gives away purified water. Impurities in the water are concentrated in the reject stream and flushed to the drain. These membranes reject the salt ions while letting the water molecules pass through them. The materials used for RO membranes are made up of cellulose acetate, polyamides, polymers, etc.

RO is capable of removing 65 different contaminants including lead, chlorine, fluoride, dissolved salts and more. Water Purifier also requires electricity to work, but it doesn't need additional power to boost the Tap Water Pressure. The UV Water Purifier can work with Normal Tap pressure. The UV Water Purification system can kill all the Germs, bacteria and the Viruses present in the water but the dead bacteria will remain in the water. The UV has proven to be a reliable and cost effective methods of water purification. The UV technology is chemical free, and it does not change the taste and the color of the water.

### 1.2 UV Water Purifier (Ultraviolet Filtration):

The UV Water Purifier also requires electricity to work, but it doesn't need additional power to boost the Tap Water Pressure. The UV Water Purifier can work with Normal Tap pressure. The UV Water Purification system can kill all the Germs, bacteria and the Viruses present in the water but the dead bacteria will remain in the water. The UV has proven to be reliable and cost effective methods of water purification. The UV technology is chemical free, and it does not change the taste and the color of the water.[4]

### 1.3 UF Water Purifier (Ultra Filtration):

The Ultra Filtration, which is termed as UF, is another water purification which works with electricity and completely kills and removes all the Bacteria, Viruses and other microorganisms from the water. The UF Water Purifier doesn't require electricity since it doesn't require Tap water pressure and works well with the regular pipe water pressure. The only lag about the UF water purifier is that it

will not remove the Dissolved solids in the water. So, you can use the UF purifier only when you are sure about the Level of the Dissolved solids in the water.[4]

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### 1.4 About TDS meter

In this project we have connected digital TDS meter to the purifier to get the indication of impurity present in water. TDS Meter indicates the Total Dissolved Solids of a solution, i.e. the amount of dissolved solid particles in water. Dissolved ionized solids, such as salts and minerals, increase an electrical conductivity of a solution. It is volume measure of ionized solids. Thus, electrical conductivity can be used to estimate TDS. Dissolved organic solids, such as sugar and microscopic solid particles (such as colloids) do not affect the conductivity of the solution.[2]

Some dissolved solids also come from inorganic materials such as rocks and air which may contain Calcium bicarbonate, nitrogen, iron, phosphorous, Sulphur or other minerals. Most of these materials form salts, which are compounds which contain metal and non metal. Water may also contain metals such as lead or copper. The EPA Secondary Regulations advise a maximum contamination level i.e. MCL of 500mg/liter (500 parts per million (ppm)) for TDS. When TDS level exceed 1000mg/L, it is considered unfit for human consumption.

### 2. Algorithm:

$(\text{Tap TDS} - \text{RO TDS}) / (\text{Tap TDS}) \times 100 = \text{Percent Rejection}$

#### Example:

Tap TDS = 352 ppm and RO TDS = 18ppm  
% Rejection = 94.9%

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### 3. Procedure:

RO systems are simple to design and operate as they have low maintenance and are modular in nature. RO systems allows the recovery or recycle of waste process streams with No effect on the material being recovered.

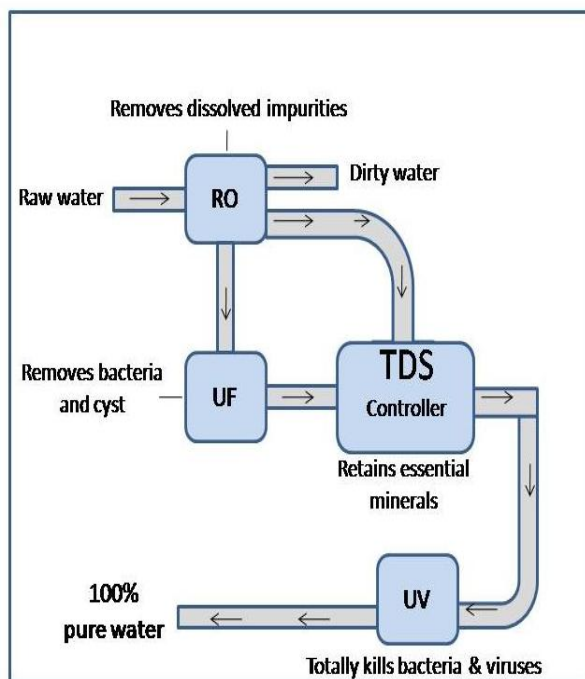
- RO membrane systems often require less energy and offers lower capital and operating costs than other conventional treatment systems.

- RO processes can considerably reduce the volume of waste stream so that these can be treated more efficiently and cost effectively by the processes such as incineration.

It is the process in which the pressure is applied to the water so that the solute remains on one side of the membrane and the pure water is collected on the other side.

TDS sensor consists of TDS meter, this continuously monitors the quality of the purified water at the output of purifier. It will do nothing if the TDS value of water remains above the predefined value. If the value of total dissolved solids goes below the level, the TDS meter will generate a signal.

The main application of TDS is in the study of water quality. Although TDS is not generally considered a primary pollutant (e.g. it is not deemed to be associated with health effects). It is used as an indication of an aggregate indicator of the presence of a broad array of chemical contaminants in drinking water.



3.2 Figure working of RO water purifier

#### 4. Observation and result:

The water coming from the outlet of purifier was pure in comparison with the water coming from the tap (in inlet). The impurities remained in one side of the semipermeable membrane and we get pure water from the other side.

As such there is no minimum TDS limit defined for any form of water. The lesser the TDS reading, the better the quality of water. Minimum TDS level based on some studies should be close to 30 ppm which keeps the mineral levels in check. The Bureau of Indian Standards (BIS) states the upper limit of TDS in drinking water at 500 ppm. Crucially the standard also states that in case no alternative source of drinking water is present, so this upper limit can be relaxed to 2,000 ppm.

So, technically maximum TDS obtained by RO filter should not exceed 500 ppm and for health purposes, it should below 75 ppm. Also normally available domestic RO filters won't be able to handle water of more than 2500 ppm effectively. [5]

#### 5. Future scope

We can further improvise this by installing the different sensors with the TDS meter so that it can sense the increase in Total Dissolved Solids in water. Also we can connect it to our cellphone, so whenever the limit is crossed it will send a signal in form of message in our mobile.

## 6. References :

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