

Sristi Summer School 2017

May - June 2017, Grambharti, Gandhinagar

WATER PURIFICATION

Team Members:

MOHIT DALAL –IIT DELHI

KARTIK CHOUDHARY –IIT DELHI

Problem Statement

Clean, safe drinking water is scarce. Today, nearly 1 billion people in the developing world don't have access to it. Yet, we take it for granted, we waste it, and we even pay too much to drink it from little plastic bottles. Water is the foundation of life. And still today, all around the world, far too many people spend their entire day searching for it. Half of the beds in the hospitals are occupied by patients of water borne diseases. Considering water purification as a global issue here sristi summer school has given top preference to this problem.

Problem Statement: Water purification based challenges which includes

- 1) low cost removal of iron (north east India)
- 2) Removal of arsenic (East india)
- 3) Removal of fluoride (Western India)
- 4) Saline water to potable water using solar energy

Initially we focused on removal of fluoride and iron from the water that are prominent in nearby regions like patan and kheralu. Along the project our problem statement changed to making potable water from the saline water used to do salt farming.

Summary

Drinking water scarcity is a major and unaddressed problem in salt farming region. Its hard to reach every home daily in that vast area so they have a supply of fresh water once in 15 days and have to store it in tanks in their small temporary houses. They have lots of saline water in wells lying around that they use for farming and they are bound to drink that it once fresh water is over.

So we had to purify that saline water to make potable water. Generally there are three major ways:

- 1) Filtration
- 2) Electrolysis
- 3) Distillation

Filtration of such water will clog the filter pores and require high pressure for the process while electrolysis would require lots of electricity.

Solar Water Distillation

Salt farmers already use evaporation process to crystallise salt .Pure evaporated water is a by product of that process. What we need is to collect that vaporised water in some way. This process can be done everyday .Distilled water is purest form of water just like rain, snow, dew, fog etc... It is free from all impurities including viruses and bacteria.

Prototyping:

Materials required- PVC pipes and a plastic sheets (To avoid corrosion and make light weight and temperature resistant)

Structure-Pyramid (To utilise maximum sunlight at all times and aerodynamic to make it high wind resistant)

These factors make it portable and easy to use product. Also we made it of 1m*1m size so that we can check the efficiency per square meter. And in future we can calculate the number of units required to fulfil a family's need.



How to use:

We need to fill up water in a container or in a pit and place this over it. The water will evaporate and then condense on the plastic sheet. It will then slide down on the sheet and collect in the pvc pipes which can then be collected through the outlet in a container.

This can fetch 2-3 litres of water per day. So we can install more such structures and get the required amount of water.





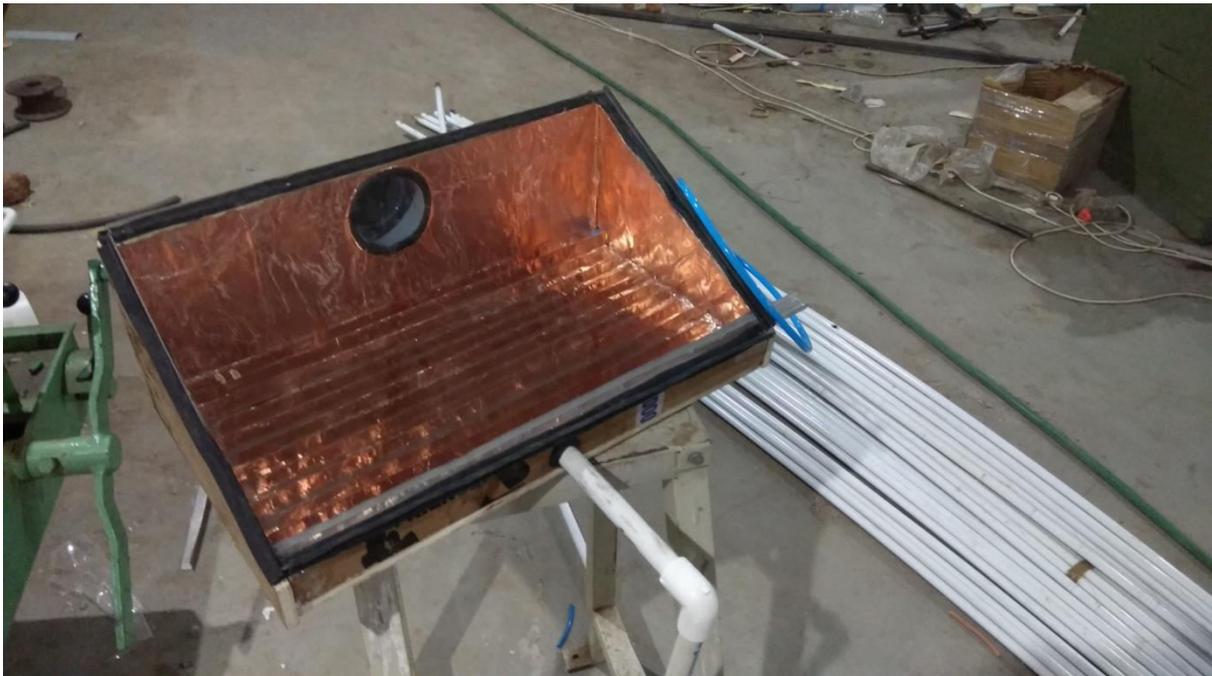
ANOTHER CONCEPT MODEL TO INCREASE EFFICIENCY

ADDONS:

Increased surface area by using copper foils

Dedicated condenser for fast production rate

Air tight sealing for conservation of maximum vapours



Prior Art Searches

We searched on the regions that have problems like impurities in water such as iron and fluoride and the practices that they use to purify water. Then we searched the standards for water to be drinkable proposed by WHO.

There are three basic ways to purify water:

1) Filtration

Natural filtration analogy using sand, grains and stones

Reverse osmosis

Candle type filters based on gravitational pressure.

PROS: fast process

Cons: requires pressure (indirectly electricity)

2) Distillation

Collection of evaporated water vapours

Collection of dew from air using cloth

Pros: Purest form of water attained

Cons: Very slow process and energy demanding

3) Electrolysis

Separation and collection of the ions using electricity

Cons: Requires high amount of electrical input

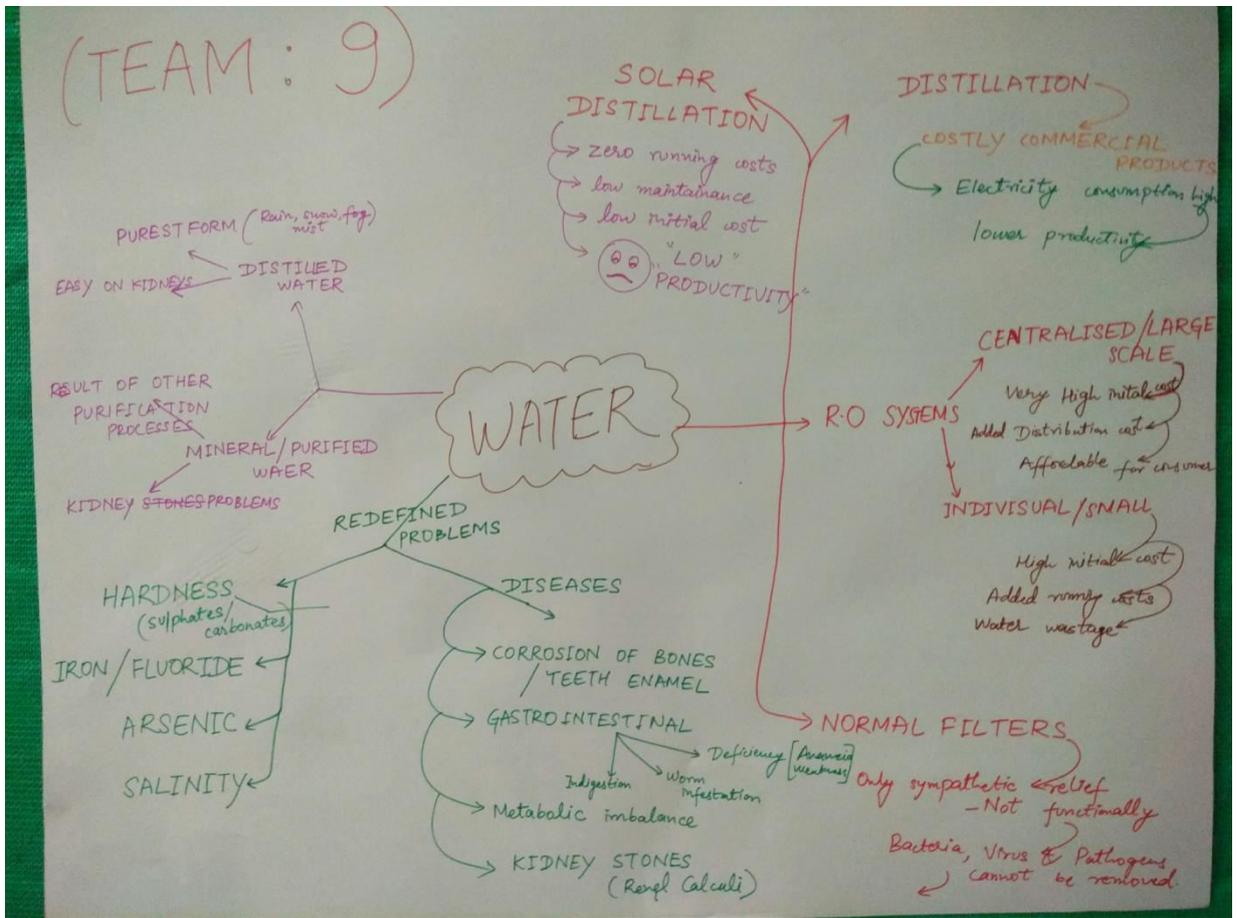
MENTOR INPUTS

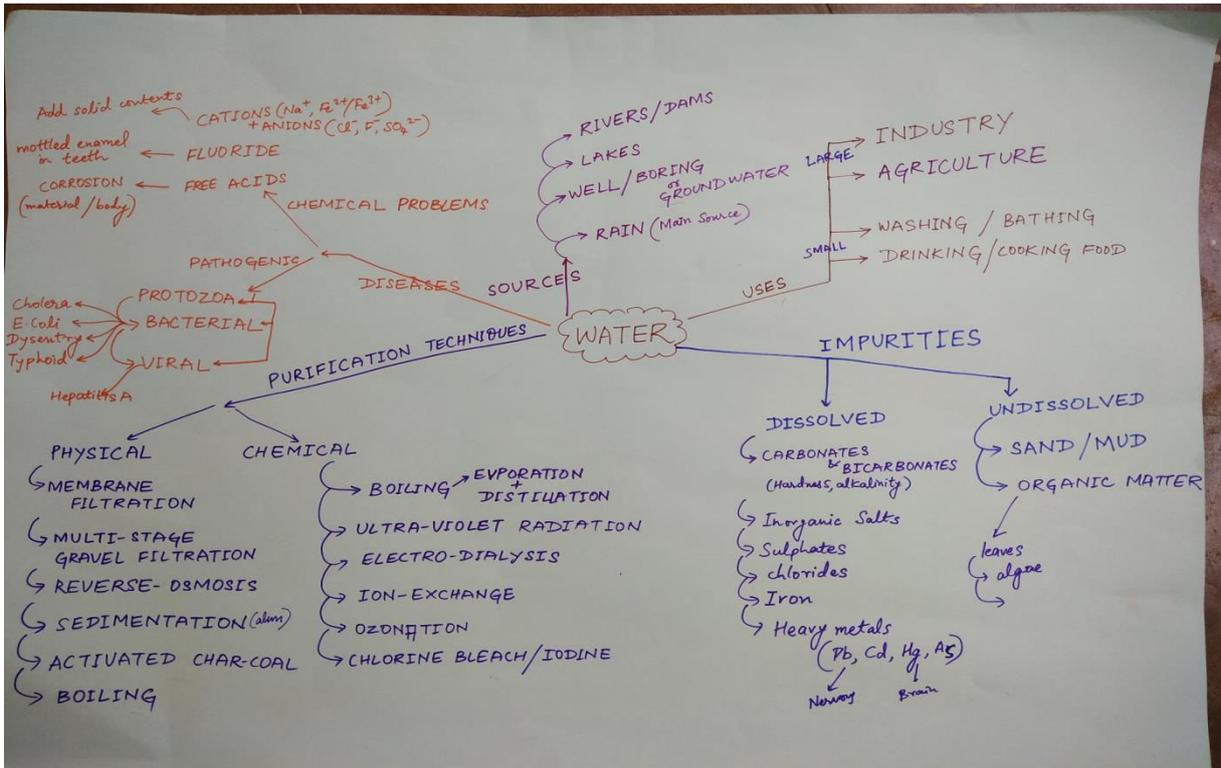
All the mentors were very keen on this problem and some of them had already worked earlier so their points laid a concrete road for us to follow. On the other hand we were the ones that were left with an open end every time we contacted a mentor. All of them had very diverse opinions upon our idea of cleaning water.

Major points to be noted were:

- Efficiency : “Kitna deti hai” is the first and most important question and this point was very crucial for user point of view.
- Application: Who is your target audience?
- Some said that water from this will not be sufficient for surviving a family needs while Others had a thought that when we have abundant area and sunlight in rural regions then why not install multiple units there and forget about efficiency.
- One problem that came with this purest form of water was that it was void of any minerals and vitamins that may be required by our body.
- Some natural water may be added to this water was another suggestion to balance the need of minerals.
- Cost of our product must be relatively less than that of cheapest filters available.
- Point that it could purify dirtiest of the water including urine for emergency cases in fresh drinkable water.

Mind Mapping





FIELD VISIT

Pure water is a basic need. Water related problems are faced globally. So we at Summer school 17 in Grambharti choose this as an important issue to be addressed. We got information about excess of iron and fluoride in nearby area such as patan, kheralu , bhavnagar and many more area where water salinity and fluoride content is a major issue.

CONVERSATION 1 (Ismael , 22 years, lassi shopkeeper)

On our first field visit we chose kheralu to get an insight of the problems people face in surrounding regions. We departed from grambharti from around 10 am on 29th may. On our way we stopped at vijapur and talk to lassi shopkeeper at the bus stand and asked him from where he gets the water and what are the different range of purified water products he has? He said that municipal water supply fulfils the basic need but supply is once in two days and irregular in quality (due to pipeline repair works/ mixing of sewer and water pipeline). It was a “kabhi khushi kabhi gam” situation for him. He also quoted that mineral water suppliers are active in the area that purify and supply water. They cost around 15 to 20 rupees for a can of 20 litres.

CONVERSATION 2 (Yusuf bhai, 30 years, pharmacy shop)

We reached kheralu in afternoon at around 1 pm. After roaming for half an hour we reached a clinic but the doctor was not available so we talked the man at pharmacy. He has been working there for 20 years. He lived in a nearby village 10km away. For day time he used to buy mineral water but at home he uses water from the bore. He claimed that he doesn't have any issues with water and they are adopted to those conditions. He also said that there is proper farming practices and abundant water for irrigation.

CONVERSATION 3 (Dr. Harshit Vaidya, 48 years, Doctor –Alka hospital)

To have an insight of the health issues prevailing in that area we met Doctor Harshit Vaidya in Alka hospital. He told us about frequent cases of stones in Kidneys (high renal calculi) because of which that area is known to be stone belt (carbonate and sulphates). Other related problems are indigestion, worm infestation and other gastro intestinal problems. The sources of water available are municipality supply, boring in urban areas and river channels, ponds in rural areas. The groundwater is prone to hardness where as the canal supplies have contamination issues.

Fluoride excess is one of the major issue and the people who are born and brought up here have discoloration of teeth and calcium deficiency that causes fractures and easy infections.

Benefits of using R O system is getting proper nutrients and Minerals, it's free of bacteria and a safe and clean drinking source. One drawback is removal of vitamin B12 from water and its deficiency leads to other health problems like anemia weakness and cramps.

Other things he added were:

People are not consuming proper amount of water as it should be 3-4 liters per day and if they are working outside and doing work then 1.2 to 1.5 times of mentioned above to supplement the basic water needs of body as lots of water is lost through sweating and urination to keep the body cool.

When we asked that how an ideal purification system should look like? His answer was, it should cost competitively with R.O and maintenance free.

CONVERSATION 4 (Ramesh bhai , 45 years, metal workshop)

We visited two three more hospitals but the doctors were not available there at that time. So we talked to a man (sitting free) who owned a metal workshop. He told that he has been drinking water from the tap since his childhood and faced problems related to digestion. He claims that he doesn't drink or smoke or eats tobacco but still he had teeth in bad condition. He had recently spent around 2000 rupees for cleaning his teeth and he is regularly taking medicines. He told that there have been problems related to Stones in kidney to his family members. He was getting purified water buy Municipal corporation nearby his workshop at a very cheap price but still he choose to drink water from tap.

CONVERSATION 5 (Manager : Vishal Soni, Worker Nitish sathwara ,23 years, purification machine operator)

The government was concerned about the problem so they installed a centralized or community purification system that has been working well hopefully.

There we talked to Nitish sathwara who the machine operator there. He works there from 8 am to 6 pm (lunch break of two hours 1-3pm).The plant produced 15,000 liters of water that fulfilled daily demands. The costs were 3 rupees for 20 litres that very cheap. He added that the filter needs to be changed after every 15 days. The machine was easy to operate as he was not skilled and just follows the basic instructions.

I visited a house in its neighbour-hood where an aunt said that they do not find much difference in the taste of that purified water.

Also in the evening we saw some roadside slum people. After talking for a while we came to know that they bring groundwater from a nearby construction site.

PROTOTYPE 1



PERMANENT TYPE SOLAR STILL

- Metal frame and galvanised sheet base
- Packaging sheet material to seal the gaps between iron and glass.
- Pvc pipes channels to collect condensed water.

Our this prototype failed in the production line only because it was very tough to construct an air tight chamber without which it was trivial.

DRAWBACKS:

- 1. NOT A LIGHT WEIGHT PRODUCT**
- 2. OUTPUT VERY LESS AS SEALING WOULD NOT BE PROPER**

PROTOTYPE 2



TEMPORARY PORTABLE STILL FOR SALT FARMERS

- Using water pvc pipes and laser plastic sheet
- Light weight and easily portable
- Aerodynamic in shape as pyramid(symmetrical structure)
- Pyramidal shape absorbs maximum energy at all times of the day.

➤ **Drawbacks:**

Installation can be made easier

Base to be provided to store saline water

Collection can be made cleaner

PROTOTYPE 3



Wooden frame

Copper foil coating for high absorbivity

Condenser for fast cooling of water vapours.

Dedicated channel for water on evaporation surface.

Rubber sealing for conservation of water vapours

Glass for heat trapping and temporary surface for condensation

Drawbacks:

Not much increment in output(May be but we could not test it due to rain)

BILL OF MATERIALS

PROTOTYPE 2(PORTABLE FOR SALT FARMER)

PVC PIPES 10M *8RUPEES/M= 80RUPEES

PLASTIC SHEET 5M*1M =50 RUPEES

TAPES AND WIRES 20 RUPEES

TOTAL =150 RUPEES

PROTOTYPE 3(PERMANENT CONCEPT MODEL)

WOOD 1*1.5M SQUARE =150 RUPEES

COPPER FOIL= 100 RUPEES

PVC PIPES AND CONNECTORS=100 RUPEES

GLASS SHEET=150 RUPEES

SEALANTS=100 RUPEES

TOTAL=600 RUPEES

ROAD AHEAD

“The road not taken”



We chose the path which had lots of ups and downs in terms of convincing the mentors through our proper arguments to analysing the problem to grass root level. This field seems to be not explored up to the mark and there is surely something hidden in this simple and wonderful logic. Its our fortune to get to work on this project and we would like to take it to new heights. Hope to see many others along our journey.....