



17th WEDC Conference
Infrastructure, environment,
water and people
Nairobi, Kenya 1991

Portable water treatment plant

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INTRODUCTION

Sudan is one of the largest African country with an approximate population of 22 million. However, basics of life, one of them being clean drinking water, is not easily available in far-flung villages forcing the inhabitants to drink untreated unhygienic, raw water, leading to spread of diseases. Imported water treatment plants, which are generally compact with rapid pressure filters of around 20 m³/hour, were found to be too costly and furthermore entailed payment in hard currency. It was basically this situation that led me to think, design and fabricate a simple water treatment plant which could easily be operated and maintained by the villagers themselves.

Portable Rapid Sand Filter Plant

The generally recommended method of water treatment in the developing countries for surface water is the slow sand filter because it is simple and cheaper as no chemicals are used. However, such a plant is not suitable for water with high turbidity and colour. Hence the need to use either the rapid sand gravity filter or the pressure sand filter.

Aqua-Sudan-40 Portable Rapid Sand Filter

This plant is a compact rapid sand filter working by gravity, designed, fabricated and commissioned by the author to produce 40 m³/hour (8800 Imperial gallons/hour) adequate to meet the drinking water needs of a population of 22,000 inhabitants at a consumption rate of 10 gallons per capita per day. The plant is installed in a village, Gamalab, situated on the banks of White Nile and continues to operate troublefree for the last several months.

In this plant, the raw water is pumped into a flocculator (around the end baffled weirs) where Calcium Hypochlorite and Aluminium Sulphate solutions are added to the raw water for coagulation, flocculation and chlorination. The water then falls into a first precipitation zone with a checkview

glass manhole, thereafter flows into a second precipitation zone similar in shape as the first one but contains high rate tube settler zone. At this point, Sodium Carbonate solution is added for pH correction. In the first and second precipitation zones, sludge, flocs and suspended solids are precipitated and can be easily drained off through blow-off sludge valves. The high rate tube settlers provide a better laminar flow, reduces the settling path thereby increasing the hydraulic capacity of the plant saving space and cost and allows tiny flocs and suspended solids to accumulate and settle down in the sludge pocket.

In the last stage, the water flows into a rectangular aerator weir from the four sides into the rapid sand filter which is 3.4 m³ of sand fine granules (0.4 mm to 0.8 mm). Underneath this filter, a 8 cubic metres reservoir is installed to collect the filtered water to the consumer.

To facilitate easy operation, control and backwashing of the plant, raw water pipe, overflow pipe, wash water pipe with a control valve, air scour pipe round the filter filling pipe, treated water off-take pipe and backwashing water pipe are incorporated in the design. In addition, a safe platform is added to aid the operator to supervise the plant and to re-fill chemicals in containers installed at a height to aid flow by gravity.

The operator therefore can easily see the process, avoid filter problems, like clogging, sand escaping, head losses, etc. Besides for equal sized plants, a small high lift pump is required than in a pressure type.

The estimated cost of this entire plant (inclusive of all costs) is approx. US\$ 20,000 while a 10/15 m³ imported plant costs in the Sudan in the region of US\$ 40,000.

Being locally made, this plant offers a practical solution to water problems in small villages, refugees camps, small industrial units, hotels, etc. It is noteworthy to mention that the final water characteristics match with WHO (World Health Organisation) standards, chemically, physically and bacterologically and hence fully fit for human consumption.

Material And Labour Used

- Mild steel sheets 5 to 6 mm thick
- Mild steel angles 3" and 4".
- Diesel pumps (as electric power is not available in the said Village)
- Timber
- Galvanised pipes 4", 3", 2" and 1".
- Anti-rust paint

Labour used was of skilled and semi-skilled category, as follows +

- 3 skilled welders
- 2 skilled fitters
- 1 assistant fitter
- 1 painter

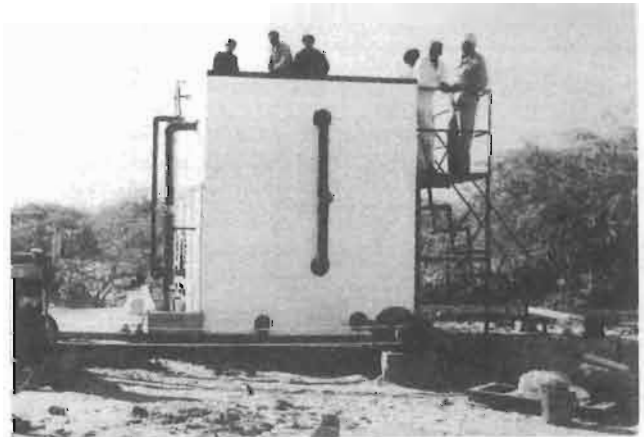
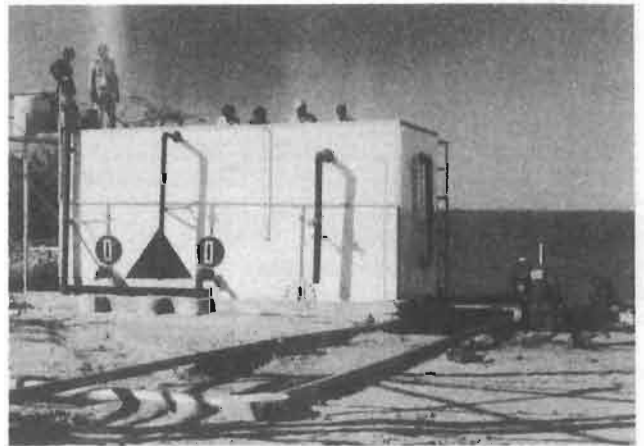
Equipment Used

- welding machine
- wrenches, spanners & threading machine
- grinding stones, drills.

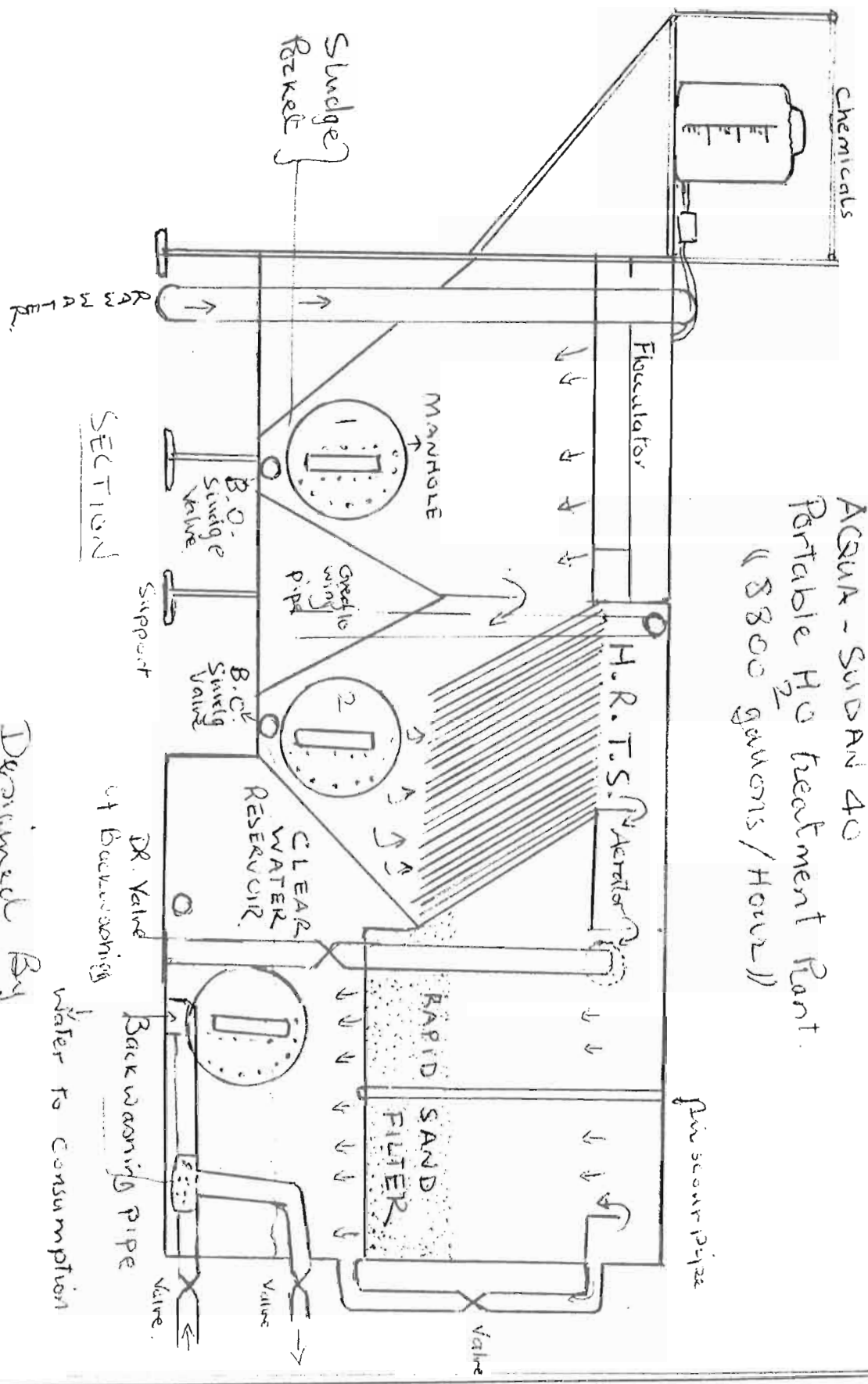
The entire plant was fabricated and commissioned in 40 days with the team working from 6 am to 6 pm. Minor problems were easily overcome with ingenuity on the part of the team.

Maintenance

Every one month, the manholes should be opened to desludge precipitation from sludge pockets and to inspect filter condition.



ACWA - SUDAN 40
Portable H₂O treatment Plant.
(8800 gallons/Hour)



Designed By
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