Energy Globe Competition

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Safe Drinking Water Filtration Unit for Rural Communities

By

Dr Salih A. Hamadto
Director, Solar Energy Enterprises Co Ltd
P O Box 13432 Khartoum SUDAN

email: hamadtosa@hotmail.com

Mobile Phone: +249 912392526

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A) SUMMARY

Drinking water clarification/filtration units, targeting rural communities, have been designed and locally constructed, with installations and successful operation covering villages in Northern and Southern Sudan. The basic unit incorporates an innovative static clarifier. It is made from steel treated with epoxy paint and is rigidly mounted on a skid, whereas it can be hauled to and deployed by the surface water source without the need for expensive site civil infrastructure. Safe drinking water is produced at rates of up to 12 m^3 per *hour*. Power consumption by the intake and dosing pumps is around 3kVA, supplied by a small electric generator.

Design and Construction Team by Mirmir Unit
Before Dispatch to Site

B) Detailed Project Description

Above Unit Operating at Site in Mirmir, Southern Sudan
(Commissioned March, 2005)

B.1 Project Concept and Rationale:

Rural communities in Sudan consist of a large number of groups of few people scattered over a vast stretch of land. Most of these communities do not have facilities for producing safe drinking water. Providing central stations and long delivery grids for such demography - geography seems to be out of reach within the foreseeable future.

To address this problem, the applicant, through his own private business, has developed a small filtration/clarification unit for use by rural and peri-urban communities living close to surface water sources. The unit is extremely robust, can be manufactured using locally available materials and technology, easy to transport and deploy at site without the need for expensive civil works, simple to operate and requires minimal energy for its operation (3 kVA). It is versatile enough to supply the daily needs of safe drinking water of up to 5,000 people, from a variety of sources, be it river, hafir (pit) or swamp.

B.2 General Description:

The salient features of the unit are the following:

- An intake pump on a small pontoon deployed inside the water source.
- A static clarifier, with an innovative proprietary feature, to enhance sedimentation. Valves at the bottom of the clarifier are incorporated to remove sediments.
- A mixing tank on top of the clarifier.
- A small electric dosing pump.
- Two sand filters with media (gravel and sand).
- A collection tank, which can be used for direct water supply. Provision is made for connection to an elevated tank. Chlorine compound powder solution is applied manually for disinfecting the clean water.

- The clarifier, mixing tank, filters and collection tank are made of sheet steel, cut, rolled or bent and welded. Internal surfaces are treated with epoxy paint. The whole unit is rigidly mounted on a skid.
- Operation is simple, consisting basically of switching on the supply pump and then adjusting valves, so that “water in equals water out”.

B.3 Operation:

General: The receiving tank has a floating switch to shut off power when it is full. Operation time is 10 to 20 hours per day.

Power requirements is 3 kVA, AC for the intake and dosing pumps, supplied by a small electric generator; the filter backwash pump (I kVA) is operated from the same power source when the station is shut off. Additional 3 to 7 kVA shall be needed for additional pumps, e.g. for pumping into an elevated tank.

Output: The unit will initially need about two hours to fill (start-up). Thence after, under steady state operation, it will deliver ***8000 to 12000 liters per hour*** (depending on the turbidity of the water). When the receiving tank is filled up (1 to 1.5 hours), water should be pumped into an auxiliary storage facility (e.g. an elevated tank) or used directly. Otherwise the station must be shut off.

Sediment Removal: Water sediments settle in the main clarifier tank, with the mud accumulating at the bottom. Four 2” valves at the bottom of the clarifier vessel are operated manually to remove this mud. The frequency depends on the level of the turbidity. Usually once or twice monthly opening of these valves should be enough.

Filters: The unit is provided with a filter backwash pump. The frequency of cleaning the filters is a function of the turbidity of the raw water, varying from once a month to once weekly at exceptional turbidity level.

B.4 Time Line (see photos in section D under):

1999 – Photo D1: The first product was a “standard” mini water station made for the Sudanese Standards and Metrology Organization. It was a working replica of water stations operated by the Municipal Water Corporation for drinking water supply to cities. The station was used to determine the dose of flocculant needed for the main stations at various turbidity levels, and also for research on the effects of residual flocculants on human and marine (river) life.

The success of this initial effort has prompted the research and development of the rural stations project.

2000 – Photo D2: Installation and operation of the first rural unit in Tangasi, Northern Sudan. It was not a compact unit, yet the salient features, including the innovative clarifier, were there.

2001/2003 – Photos D3/D4: Two installations in villages near Bentiu, Southern Sudan. These were a “Mark I” version, employing manual dosing, whereas flocculant was mixed with water in a 40 liter drum and the mixture adjusted to drip into the incoming raw water over the period of daily operation of the station.

2005 – Photos D5: Installation in Mirmir, Southern Sudan. This was a highly successful project, with water supply extended to neighboring villages.

2007 – Photo D6: Two units have been completed at the workshop. They are awaiting dispatch to locations in the Northern Province, near Merawe.

C) Points for Evaluation Criteria:

- **Project aim:** To provide safe drinking water from surface sources to rural communities through the local development, manufacture and dissemination of small filtration/clarification units.
- **Innovative aspects:** Ruggedness, transportability, simplicity of installation and operation and very low power consumption, are salient features of the unit used in this project.
The design of the static clarifier has innovative features, some proprietary. The cylindrical steel vessel is the surface of revolution of a section through a simple inclined plane clarifier, whereas the inclined plane becomes a cone. This design, which has produced very efficient sedimentation, also makes the unit highly portable. With the availability of sheet metal rolling technology (used for decades in fuel and water tank construction), the rugged cylindrical shape of the vessel is simpler and much cheaper to produce locally than the straight plane structures commonly used in small clarifiers.
- **Cost/benefit:** The social benefits of providing drinking water to human communities cannot be overstressed. The cost of this locally – manufactured unit is much lower than imported ones. Provision of spare parts and services is handy. Its rugged steel structure has a very long life expectancy.
Note: ***The cost of research and development of these units was covered by the applicant and his private business. All above units were sold to companies and organizations who acted as project sponsors for the communities concerned. This has been a commercially successful project.***
- **Replication potential:** This project can be implemented anywhere. Already, installations have covered locations in extreme northern and southern Sudan.
- **Environmental compatibility:** The emissions from the power source (the 3 kVA generator) in this project are insignificant. The main waste is the sediment mud, which is part of the environment. Residual flocculant has been certified safe to humans and marine life.

D) Documentation Material: Photographs

Photo D1
Khartoum Municipal Water Works – 1999
Mini Water Station For the Sudanese Standards and Metrology Organization

Photo D2
Tangasi, Northern Sudan. 2000.
Standing Left: Project (lady) supervising engineer; Right: Village Sheikh.
Sitting on tank: The Four technicians who built the station.

Photo D3

Photo D4

Thoan Village, Near Bentiu, Southern Sudan. 2002

Photos D5
Mirmir, Southern Sudan. March, 2005
Bottom: floating pump in water source

Photo D6

Two Units at Workshop Awaiting Dispatch to the Northern Province