Pure water on board

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The 'Jibon Tari' (Boat of Life) is a fully equipped floating hospital which since its launch in April 1999 has enabled 31,000 people in the riverine areas of Bangladesh to have access to medical treatment. Over 5,000 operations have been performed to restore sight, hearing or mobility. During the planning and construction stage it was decided that an essential requirement would be a safe water supply, that could be used with confidence for all clinical procedures and drinking purposes. The objective of the IMPACT Foundation was to ensure that the supply on board should meet the WHO guidelines for drinking water. Initially it was thought that this could be achieved by purchasing pure water and storing it on tanks on board. Later research indicated that this would not only be expensive, but also impractical. Advice was received from our partner organisation in Nepal that a supply of pure water could possibly be achieved by installation of a Reverse Osmosis Water Treatment Plant.

Technical requirements

The Riverboat Hospital is a 3-deck barge of 40 metres by 10 metres that is moved from location to location by tugs. There are two generators on board, each with a capacity of 145Kw, 380-400 volts. The structure incorporates two storage tanks 9m x 2.5m x 2.5m deep that can be used for storing raw water or pre-treated water, and two similar size tanks are available for storing treated water following processing by the reverse osmosis unit. Three tanks are situated on the upper deck to supply treated water to various usage points under gravity flow.

The 'Jibon Tari' Floating Hospital
(Pic: Tim Huelin/Christian Keenan)

The Reverse Osmosis System was required to treat river water with total dissolved solids of not more than 3000 ppm. A minimum requirement of 20 cubic metres per day with an average flow rate of 1,000-1,500 litres per hour was needed.

Procurement issues

The technical specification and output requirements were passed on to three companies who we were advised had experience in this technology. One of the main problems was that although reverse osmosis technology was well established, the system we required would need to deal with various ranges of raw river quality. One of the three companies accepted the challenge of designing a system that would be able to cope with raw river water in the various sites where the riverboat would be operating. River water analysis was an essential element of this water production operation and this was obtained from Bangladesh University of Engineering and Technology.

Eventual design

Our initial discussions with the supplier indicated that the system we required could be supplied 'off-the-shelf'. However when visiting the riverboat to discuss fitting, it was apparent that the riverboat demanded an unique system that would need to be designed around the existing arrangement of storage tanks and piping. This required considerable discussions with the shipbuilder, at a time when construction of the vessel was almost complete and plans for clinical activity were being finalised. An additional problem was that the supplier was based in India, and that the equipment would have to be transported and cleared through customs within a tight timeframe. This required considerable liaison between manufacturer, the boatbuilder and IMPACT Foundations in the UK and Bangladesh.

The installed plant consists of a series of dosing pumps, filters and settling plants. The key stages in the production of potable water are:

- Alum dosing of the raw water for coagulation of suspended solids
- Sodium hypoclorite dosing of water in the feed piping of the filtration unit for the oxidation of organics, iron and the disinfecting of raw water

- Water is then pumped through a sand filter for removal of completed suspended solids and iron, followed by pumping through an activated Carbon Filter to absorb free chlorine
- The treated water is then passed through an ultra violet disinfecting unit followed by fine filtration of 10/5 micron rating
- The final stage is passing the water through a membrane filtration unit (Reverse Osmosis) that will produce potable water.

Installation and modification

The Reverse Osmosis System required alterations to the piping system and modifications to the original water tank arrangements on the vessel. Sludge pumps were also required for discarding the settled sludge into the river.

Maintenance and testing

A further consideration during the procurement process was that the plant should be relatively easy to maintain. This has proved to be the case. The engineer on board has been trained to follow the operating manual and carry out various tests to ensure water purity. Samples of water are sent for analysis on a regular basis.

Running costs

One important criterion was that the costs of operating the system should be as economical as possible. The estimated revenue costs per litre of pure water produced were requested, but this appeared to be an impossible figure for the manufacturer to produce due to the uniqueness of the particular operating conditions. After twelve months of operation, the costs, supply of chemicals, renewal of filters, and supply of power are higher than we originally estimated (approximately £100 per month) but this has to be off-set against the benefits described below.

Benefits

The reverse osmosis plant is producing up to 1,000 litres per hour of water. This is more than sufficient for clinical and drinking purposes. This output allows the boat to store up to 50 tonnes in the storage tanks, a sufficient reserve in the event of any breakdown in the system. An added advantage is that pure water from the riverboat can be pumped on-shore to provide a safe supply (albeit temporary) for the local community at various project sites.

This project demonstrates that technology is now available to produce pure water from a varying range of raw river water, and that a continuous supply of safe and potable water is sustainable on board in all riverine conditions. This is not only environmentally sound, but it is also making a significant contribution to the prevention of disease in Bangladesh.

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