

DESALINATION OF WATER

As a part of national programme to improve the quality of life in society by induction of application of nuclear energy, BARC has developed desalination and water purification technologies on Reverse Osmosis (RO), Multi-Stage Flash (MSF), Low Temperature Evaporation (LTE), Hybrid System and Domestic Water Purifier. The 1800 m³ /day seawater reverse osmosis (SWRO) plant com-

missioned in the year 2002 has been operating satisfactorily producing potable water. Indigenously designed 4500 m³/day Multi-Stage Flash (MSF) desalination plant capable of producing ultra pure water of less than 10 ppm, is at an advanced stage of construction with the installation of most of the equipment. The work on coupling of MSF with MAPS has been completed.



Desalination unit attached to CIRUS



4500 m³/day Multi-Stage Flash (MSF) Plant under construction at Nuclear Desalination Demonstration Plant (NDDP), Kalpakkam

The Low Temperature Evaporation (LTE) plant of 30,000 litres per day capacity designed to utilise waste heat from CIRUS reactor has been operating satisfactorily and meeting the demineralised water requirement of the reactor. Such plants would be ideal for industries where waste heat is available

The design of Advanced Heavy Water Reactor (AHWR) includes a 500 m³/day sea water desalination plant. BARC has signed an MoU with the National Institute of Ocean Technology (NIOT), Chennai for providing consultancy services on Low Temperature Evaporation for sea water desalination using ocean thermal energy.

The brackish water Reverse Osmosis (RO) plant installed at Satlana village, Jodhpur district operated satisfactorily providing safe drinking water to villagers. The capability of reverse osmosis plants to provide safe drinking water from fluoride contaminated brackish water sources was demonstrated at Pedda Thanda village of Nalagonda district of Andhra Pradesh. Work on building a 50,000 litres/day barge mounted desalination plant for providing drinking water from seawater is currently going on. This plant is expected to be ready for deployment by December 2005. Development of Centrifugal Reverse Osmosis was taken up. A MoU was signed with the Bharat Petroleum Corporation Limited, Mumbai for providing consultancy on their existing RO plant for waste water reuse and cooling water system.

At BARC in an effort to indigenise high tech membrane technology, Thin Film Composite polyamide based brackish water membranes were prepared. They are undergoing long-term performance tests. A casting machine for making 2512 spiral elements was developed. Another casting machine was developed for



Pictures above: Casting machine for making thin film composite membranes spiral elements (below)

producing larger membranes (8040 spiral elements). Fabrication of the machine is continuing. The possibility of developing large size nuclear track etched membranes with controlled pore size characteristics in the sub-micron range is being explored for various medical, industrial and water treatment applications. The domestic water purifier developed by BARC to provide safe drinking water at the point of use, met with a good success. Five out of twelve parties to whom the technology was transferred came out with marketable products. The device is very compact and portable. It does not require any electricity or addition of chemicals.

Symposium on Desalination and Water reuse

BRNS in collaboration with the Indian Desalination Association, had organized a 2-day Symposium on Desalination and Water Reuse (TSDWR-2005) during February 10-11, 2005, at Trombay.

Dr Anil Kakodkar, Chairman, Atomic Energy Commission, while inaugurating the symposium, pointed towards the pressure on water resources with increasing population. He stressed the need for having residential colony with minimal water discharge and rain water harvesting, and said that it might be cheaper to desalinate sea water than transport potable water through tankers. He mentioned about BARC's technology of producing dual quality desalinated water for process requirement from low pressure waste steam from nuclear power plants and mixing it with reverse osmosis water to provide potable water. At Kudankulam where a new nuclear power plant is coming up, only sea-water after desalination is used for drinking and construction purposes. He emphasized the need for R&D activities to develop better long lasting RO membranes and effective heat transfer surfaces, and making linkages with conventional knowledge.

Dr. S. Banerjee, Director, BARC had presided over the function. While addressing the scientists he referred to the RO unit, setup by BARC at Kalpakkam and barge mounted RO plants being developed by BARC for making water available at different locations depending on seasonal requirements.

The symposium brought together the desalination technologies and water management experts from the government sector, industries, research and development organisations and academia from the country and abroad, to share their experience with end objective of availing water at affordable cost.

spO₂ Monitor



spO₂ Monitor in use

Continuous blood gas monitoring is essential for the patients with cardio-respiratory complications. It necessitates withdrawing of blood samples from the patient periodically every 10 minutes to half an hour. In view of the invasive nature of this procedure there is a trend to monitor the same non-invasively from the fingertip of the subject employing optical absorption properties of the blood for the past two decades.

Transmission characteristics of oxy-haemoglobin and reduced haemoglobin in the visible and infrared regions of electro-magnetic waves show that oxy-haemoglobin gives maximum response at 650nm and reduced haemoglobin at 850nm. Also at 805nm, the transmission co-efficient of oxy and reduced haemoglobin is nearly equal. Therefore, the assessment of blood volume changes in the fingertip using photo transmission plethysmography at 650 and 805 nm can be used to the relative concentration of oxy-haemoglobin and total haemoglobin.

The spO₂ monitor developed at BARC employs infrared and red light emitters with a common photo sensor mounted on a clip, which can be attached to the finger. The photocurrent generated in the photo-sensor is detected and processed to obtain blood volume changes corresponding to 650 and 805nm. These blood volume changes are further processed to obtain the oxygen saturation percentage of the blood. The module developed for spO₂ monitoring has a RS-232C output, which can be connected to the existing patient monitors. The module is being evaluated for clinical use and will shortly be available for transfer of technology.

Anu-Photo Rheograph



Anu Photo Rheograph in use

Anu-Photo Rheograph, based on the principle of photo transmission plethysmography, has been developed for the routine measurement of blood flow as well as assessment of autonomic nervous system. It is different from commercially available Photo-Rheographs in two respects: 1) It measures the transmission of infrared light in place of reflection and (2) It gives rate of change of blood volume in place of change in volume as a function of time and therefore is more accurate. The system comprises of infrared transmitter and a photo receiver, which can be suitably placed on the finger or toe of the subject. The light received is processed to obtain rate of change of blood volume and connected to a personal computer through the serial link with the help of an embedded processor. The output can be viewed on the PC monitor.

The peripheral blood flow measurement carried out with Anu-Photo Rheograph as well as conventional impedance cardio-vasograph has shown the former to be more simple and reliable in patients with radiation injury, Raynaud's phenomenon and thoracic outlet syndrome. Comparison of Heart Rate Variability (HRV) and Blood Flow Variability (BFV) obtained from Anu-Photo Rheograph and Medical Analyzer have shown HRV to be similar in both the cases and BFV to be better revealed on Anu-Photo Rheography. Because of the easy applicability and availability of disposable transducer, Anu-Photo Rheography is the method of choice for monitoring distal blood flow and physiological variability for diagnostic purpose as well as monitoring the therapeutic response of various medicines.