

# Report on water R&D for May and June 1990

David Sinclair

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This report summarizes the progress made on water research topics between the April collaboration meeting and the end of June.

## 1 Biolabs purification system

The Biolabs water purification system is fully operational and preliminary tests have been carried out with it. A number of areas of concern have been identified which will require further investigation:

1. The fouling index of the water entering the R/O is slightly higher than desired (5.5 instead of 5.0). We will replace the 3.0 um filters with 1.0 um filters to correct this. We may want a regenerable prefilter for large volume operation but should assess this when more data are available on the mine water quality.
2. The R/O unit produces about 36 l/min of purified water instead of the required 50 l/min. This may be due to the low temperature of the incoming water and suggests the need for a heater on the inlet water.

The quality of the water produced looks very good with conductivity below the limit of sensitivity on the meter provided.

3. The Ionpure unit produces water of very good quality (10 M-ohm-cm) but only if a rather high rejection is used (33%). Ionpure suggest that as the incoming water from the R/O is very clean we could operate the unit at higher electric field and hence get better extraction. This requires a new power supply.
4. The sensitivity of the conductivity meters around the IX columns is not sufficient to asses their performance. Biolabs have promised to replace these with more suitable units.
5. There is a need for more instrumentation (several temperature probes, better conductivity meters additional flow and pressure indications) in order to monitor the system. Some of these have been implemented but additional effort is required to complete the task.

In spite of the above difficulties I felt that the commissioning went very smoothly for a system of this complexity.

## 2 Ten Tonne Test Facility

The installation of the TTT is progressing. Most of the PVDF plumbing connecting the tanks with the Biolabs system is installed and this work should be completed shortly after the return of the technician skilled in PVDF welding (mid July). A level control system based on ultrasonic monitoring is being designed.

## 3 Radon TPC

The critical path item on the TPC is the electronics. Four 32 channel preamplifier cards are required inside the TPC to condition the wire and cathode strip signals. These have now been designed, the CAD artwork completed and the PC boards have now been delivered. The components

must now be installed and the boards tested. Four 32 channel discriminator cards are required which will be mounted in the FASTBUS crate. These have been designed, CADed and sent out for manufacture. Both circuits were fully breadboarded so I am optimistic that there will be no further major delays. However, this task is about 6 weeks behind the schedule which I made up in March.

The gas control, vacuum and high voltage systems of the TPC have been tested. One of the vacuum pumps died but this is thought to be old age rather than any fundamental problem. Components have been ordered to allow the calibrated 220Rn source to be incorporated into the system when required.

## 4 Optical Properties of Water

As reported at the April Water Workshop, an apparatus has been set up for monitoring the transparency of water at 325 and 441 nm. The initial measurements indicated that water coming out of the sampler was less clear than the water entering it. This has now been traced to the pump which has been replaced. The water now shows a consistent coefficient of  $5.4 \pm 0.9 \times 10^{-4} \text{cm}^{-1}$  at 325 nm compared with the value of  $4.1 \pm 0.7 \times 10^{-4} \text{cm}^{-1}$  obtained by Boivin et al. for NRC's best water. The most significant result of the work is that the system has proven to be a very convenient diagnostic for water systems.

## 5 Thorium Extraction

Experiments have been carried out to study thorium extraction on fine filters. Small samples (a few cc) of water spiked with  $^{234}\text{Th}$  were counted with a Ge detector and then passed through syringe tip filters. The filtrates were then counted in to establish the amount of thorium removed. Initial measurements seemed to show that while a filter of  $0.5 \mu\text{m}$  did not retain the thorium, finer filters were effective at removing the thorium. It was then realized that the pH of these samples had dropped significantly because of absorption of  $\text{CO}_2$  from the air. A second series of tests were done in which

Pore size	Initial Count	Filtrate Count	% Retained
500,000 NMW	5543	409	92%
200,000 NMW	5303	380	92%
100,000 NMW	5655	264	95%
50,000 NMW	4800	187	96%
10,000 NMW	4600	215	95%

Table 1: Extraction of thorium on polysulfone filters

the pH was kept between 6.5 and 7. The results are as shown in Table 1.

The filters are made of hollow fiber material made of polysulfone. It is clear that these filters are extremely effective at removing the thorium at neutral pH. It appears from the fact that the extraction does not depend on pore size that the mechanism for extraction is a surface adsorption on the polysulfone rather than the morphology of large colloids containing the thorium. Further tests are underway to see how this might be exploited for SNO.

## 6 Rn Emanation from stainless steel

At the April Water Workshop Jim Steinberg of Drexel reported that the rate at which radon is released by stainless steel was high (of order 200 atoms per hour per m<sup>2</sup>). Queen's have now completed their <sup>222</sup>Rn counting system and have used their system to look at <sup>222</sup>Rn emission from a couple of stainless systems. First, they determined the activity of the SS tubing in their gas transfer system to be 30 ± 20 atoms/m<sup>2</sup>/hr. They then looked at a length of SS beam tube and deduced a rate of 370 ± 100 atoms/m<sup>2</sup>/hr. These preliminary measurements confirm that there is a problem with steel and further tests are underway to investigate the problem.

## 7 Removal of NaCl from water

Mike Lowry has been looking into the feasibility of extracting salt from the heavy water underground so that successive salt-in, salt-out runs could be made. He reports that the state of the art R/O membranes would allow the salt to be concentrated to about 5% which would allow the concentrate to be stored in a 50 tonne tank. A second 50 tonne tank of clean heavy water would be required to maintain the water levels in the detector.