Perth's water to be purified by magnetic process

Perth's conventional water treatment plant should soon be joined by a novel plant that purifies water much more quickly and efficiently by using magnetic forces to help the settling out of impurities

The new 'Sirofloc' demonstration plant, proposed to be built at the Perth suburb of Mirrabooka, will treat 35 million litres a day. It follows on from the success of a 140 000-litre-daily pilot plant that turned coloured, turbid bore water containing hydrogen sulphide and organically bound iron into clean potable water.

Sirofloc was developed at the CSIRO Division of Chemical Technology and is a process whereby impurities are attracted by electrostatic forces onto small particles of treated magnetite. The particles are then magnetized, causing them to aggregate into large clumps that settle out very quickly; clean water, ready for consumption, is left behind.

Capitalizing once again on the magnetic property of magnetite, a strong magnetic field and an alkali wash are used to strip the substance from its accompanying sludge. The recovered magnetite is now ready for re-use.

The treatment reactivates the magnetite particles — they acquire positively charged surfaces — so that they attract and hold colloidal matter, algae, bacteria, dissolved coloured material, and other impurities, which generally have a negative charge.

Conventional water treatment typically uses alum to remove turbidity and colour (largely due to clay and humic acids) by flocculation. Positively charged particles of aluminium hydroxide act like the magnetite particles do and bind the impurities into loose aggregations (flocs), which later settle out.

A flocculant should have a relatively high surface area (and high electrical charge) to allow it to attract and hold the maximum amount of impurities. On the other hand, the floc formed should settle out quickly and form a sludge containing a minimum amount of water.

Unfortunately, these two requirements conflict: fine, highly charged flocculants with relatively high surface area produce flocs that settle slowly and they form gelatinous watery sludges. The cost of subsequent sludge drying and disposal can often be high.

By comparison, the magnetic flocs can be very fine, yet settle quickly because they clump together when magnetized. Sirofloc produces an alkaline liquid sludge that is easily dealt with.

Furthermore, the conventional alum process takes 1–2 hours in large sedimentation tanks, followed by filtering through sand to trap lingering particles. Sirofloc takes only about 15 minutes and subsequent filtration is not expected to be necessary. The greater speed means that the size of the plant can be reduced, leading to significant cost savings for large plants.

The specially treated magnetite will clarify waters that are hard to treat with alum, such as reservoir water. Such water is usually clear of suspended matter but coloured by dissolved organic material from surface catchment debris. The humic acids responsible for the colour, however, will readily bind to the treated magnetite.

Certain turbid waters do not respond to treatment with magnetite alone. In these situations, organic polyelectrolytes are used in conjunction with magnetite. These soluble organic polymers enable turbid waters to be clarified without the use of alum and its associated sludge problem.

The new Sirofloc plant is listed as one of the first projects to be supported by the National Water Treatment Systems Development Centre (proposed by the Department of Productivity to help the development and marketing of water treatment technology in Australia).

Two other important development works will soon be built — a Sirotherm plant to treat 5 million litres a day and a magnetic dealkalization plant (500 000 litres a day). Sirotherm is a process that uses an ion-exchange resin recharged by hot water, and the other process uses magnetic resins for treating hard alkaline water. Both were developed by CSIRO in conjunction with I.C.I.

By 1990, it is estimated that Australian cities will have expended more than $500 million on new water treatment plants. Perhaps the new CSIRO techniques will lead to reductions in the cost of purifying our water.