Sediment Remediation Technology

Between 1993 and 2001 around US$130 million was spent for sediment remediation within the Detroit River/Lake Erie basin, removing some 843,500 cubic metres of contaminated sediment and an estimated 198,000 kg of PCBs.

Years of pollution by waste from sewage, pulp and paper mills, the steel and petroleum industries, and other sources have contaminated the sediment of many of the world's harbours, lakes, rivers and canals.

Contaminants in bottom sediments can be released into the water above, to the detriment of water quality and aquatic organisms. Pollutants from sediment can accumulate in the food chain, endangering fish and birds, and ultimately humans too.

The conventional way of dealing with contaminated sediment is to *dredge* it – scoop it up and haul it away for long-term storage and possible treatment. But dredging is not always feasible if the sediment is unstable or if the water is too deep, and the process may fail if all the sediment cannot be removed.

Dredging and disposal of contaminated sediment are not only extremely expensive but can pose a risk to environmental and human health. The high cost of the *remove-and-treat* option has driven the need for more innovative technologies.

NWRI and Sediment Remediation Technology

In pursuit of a better technology to detoxify sediments, NWRI conducted extensive laboratory tests of different *in situ* methods, followed by trials in the field. *In situ* treatment has advantages over dredging, as the sediment is treated in its current location, not removed at great expense to be treated elsewhere. With *in situ* sediment treatment, chemicals are injected directly into the sediment at the bottom of a river or harbour.

These tests and trials produced one of the first commercialized on-site remediation processes. The Limnofix *In situ* Sediment Treatment Technology (LIST) uses an underwater harrow towed behind a boat to till contaminated sediment and inject it with a chemical oxidant, usually calcium nitrate.

The injected oxidant promotes biodegradation of contaminants, breaking them down by providing oxygen to the bacteria in the sediment and oxidizing the sulfides that hold back this natural process.

Although oxidization takes place relatively quickly, bioremediation can take several months – depending on the type and severity of the contamination.

In demonstrations in Canada, the United States and Europe, NWRI scientists have successfully shown that *in situ* treatment can enhance biodegradation, oxidize sulfides, and reduce sediment toxicity, so that water quality improves and aquatic habitat is healthier. Costly dredging, with its environmental risks, can be eliminated in some cases.

Impacts of NWRI Research on Decision Making

National and international environmental management agencies and governments have decided to use *in situ* de-tox methods to restore contaminated sediments:

- **some of the larger Great Lakes' ports have zones highly polluted by sulfides, heavy metals, PCBs and phosphorus from municipal and industrial discharges. NWRI and partners were asked to implement *in situ* sediment treatment for a range of contaminants;**
- **near the old airport in Hong Kong, sewage-contaminated sediment in the marine environment was causing serious odour problems and corroding nearby buildings and aircraft. A full-scale treatment was carried out and within weeks, the sediment had turned from black to brown, more than 95 per cent of the sulfides were remediated, and the odour had dissipated significantly;**
- **in the late 1990s in Salem, Massachusetts, a mudflat contaminated with coal tar from a coal gasification plant underwent two LIST treatments using an injection system towed behind a tractor at low tide. It is now 90 per cent restored. LIST has also been accepted by the United States Naval Facilities Engineering Service Center to clean up some American naval sites;**
- **NWRI, with worldwide licensee, Redlog Environmental Ltd., demonstrated the effectiveness of *in situ* bioremediation for sediments contaminated with oil from the 1991 Gulf War. This work was used to support claims to the United Nations Compensation Committee by Kuwait against Iraq stemming from the Iraqi invasion of Kuwait; and**
- **a full-scale application of the remediation technology was used to eliminate odours from the Shing Mun River in Hong Kong. This application was successful and the second full-scale treatment of the river has been recently completed.**

Benefits to Canadians

Sediment remediation technology is a classic example of good environmental practice making sound economic sense!

- the technology reduces toxicity in the environment, without risking the kind of environmental damage that can result from dredging;
- this environmental benefit is achieved at a lower financial cost, making the better environmental practice the more cost-effective one; and
- the interest in the technology in Canada and abroad indicates a considerable market potential, increasing Canada's economic competitiveness in environmental technology development.

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