Putting sediment into the flocculation holding tanks

What Polymers Did For Us

Francois Couturier of SNF looks at the history of dredging contractors using polymers and highlights industry areas where they are still bringing benefits

Over the past decade, polymer use in the dredging industry has accelerated. The main drivers are:

♦ Sediment contamination levels
♦ The need to clean water before its release into natural courses, and
♦ Lack of room and time for particle settling and drying.

The direct result of this change is a reduced environmental impact from operations and in this article I'll review dredging contractors' polymer use and look at both the current and future areas of interest.

What Are Polymers?

Water soluble polymers have been used for more than 50 years on various applications, some of them, such as drinking water production, with the highest safety criteria. Polyelectrolytes, known as flocculants and coagulants, are used mainly for solid/liquid separation. They can derive from organic chemicals (flocculants) or from both organic and mineral chemicals (coagulants).

Today, more than 1M tonnes of synthetic organic polymers are produced annually worldwide for use as coagulants and flocculants, mainly for use in water treatment and the oil and mining industries.

In 1964, the French government approved a major port extension in the Gulf of Fos near Marseille – the first large-scale project where polymers were used in port construction. The work required dredging hundreds of thousands of cubic metres of sediments, most of which were used to turn nearby marshland into usable land.

After successful small-scale trials, polymers were used for the flocculation of dredged sediments. They were injected directly at the pipe outlet, linking sand and fine particles together to create a homogeneous material useful for further construction steps. The quick water release at the end of the sedimentation slope was another major benefit, along with better water quality. Polymer dry stacking – a process borrowed from the mining industry – considerably speeded up the drying process so fine-particle soil no longer took years to dry.

The project brought together two leading companies in dredging and polymers – **Boskalis** and **SNF**.

Discovery Period

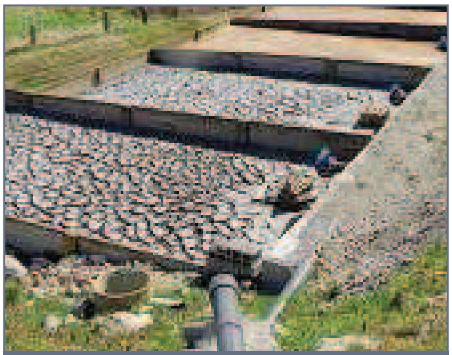
During the next three decades, the main players in the dredging and chemical industries attempted to use polymers in various applications, sometimes successfully, sometimes not.

Higher overflow clarity in settling ponds was one imperative – several US projects in the 70s used polymers for this purpose. Some dredging contractors had to build several successive settling ponds to improve the overflow quality, but local agitation at the overflow point led to permanent resuspension of fine particles. Polymers have solved this problem. The settling pond's surface area has been at least halved and drying time has been accelerated. This process is now widely used and has been extended to lake, canal, river and port dredging.

In the 1980s, many rivers and harbours reported highly polluted sediments. Mining and extractive industries' techniques for particle separation led to sand reuse after washing and pollutant concentration. Technologies initially designed for municipal water treatment in Europe and North America involving polymers for clarification and sludge dewatering through mobile units such as a belt filter press or gravity belt filter, were subsequently used by paper mills and introduced to the dredging industry.

With the 1990s came increasing legislation in a number of countries setting out maximum acceptable levels for some well known contaminants such as heavy metals, polycholorobyphenyls (PCBs), or tributyltin (TBT). Some of these were widely used in the past and later banned but were still bound into the sediment. Preliminary sampling campaigns, followed by sediment chemical characterisation, became compulsory, along with the treatment of contaminated sediments.

Over the decades, mutual knowledge and co-operation between the dredging



Polymer dry stacking, showing two stages in the precipitation of solids from contaminated sediment

Photos: SNF

Dried material being loaded for reuse at other sites

and chemical industries improved. While some dredging companies and authorities were initially reluctant to use chemical polymers to treat sediments contaminated by the chemical industry itself, the introduction of many new chemicals, as well as better communication and awareness from the chemical industry, has made polymers more acceptable. In 1993, for example, the first fixed plant for sediment treatment was built in Hamburg, Germany, to cope with the River Elbe's polluted sediments. It has successfully used polymers ever since.

Onwards And Upwards

Since 2000 the treatment of contaminated sediments for large-scale projects has become a real challenge. Many projects involving high-level contamination have no acceptable cost solutions, so some dredging companies have created their own departments to deal with this.

Boskalis, DEME and **Jan De Nul** each has experts able to propose treatment options and they can offer a global approach involving sediment removal and advanced treatment. Some do not need the polymer suppliers' support any more and are themselves experts in the interaction between polymers and sediments, publishing their findings regularly through congress papers and adding to the general pool of knowledge.

Current mobile treatment plants are bigger, with some of them built to operate for several years and may even evolve into permanent plants:

♦ The USA's Fox River sediment treatment plant (see *DPCs passim*) has the world's biggest frame filter press

♦ Some EPA superfund sites have dedicated treatment plants using the latest polymer products, such as heavy metal polymeric chelatants, and water treatment techniques, such as sand and activated-carbon filters

♦ In Antwerp, Belgium, the AMORAS permanent plant's scheduled to start later this year and will treat 1M m^3 of sediment from the port annually

♦ In China, permanent plants have been built to process sediments from several lake dredging projects, such as that in Jiangsu province. They are all benefiting from the latest centrifuge technology developments.

A further advance in the past decade has been the introduction of geotextile tubes, which allow fast water release and acceptable three-week drying times. They can be used for both small and large projects, such as the French Port of Arcachon dredging campaign or the USA's Ashtabula river project. Polymer selection still has to be made carefully since the flocculant must be resistant to the high shear generated during the filling of the geotextile tube.

Finally...

Online flocculation in hopper dredgers is a recent innovation, but needs more research and trials. It has been used recently in South Korea and Spain with success – fast sediment settling in the hopper barge and high overflow quality – but it's no cheaper than existing techniques. That said, tighter regulations may make this a more favourable option in the near future.

Overall, polymers are now better known within the dredging industry but still need a higher profile, given the large number of players involved in dredging projects – typically, local authorities and communities, environmentalists, dredging contractors, maritime engineering companies *et al*. That's why some polymer suppliers have developed a dedicated package of equipment and services that could consist of:

♦ Polymer selection, supply and training

♦ Make-up equipment for polymer injection

♦ Technical assistance at the start-up

♦ Regulatory information as required by authorities

♦ Field support to check flocculation parameters, and

♦ Compliance with local legislation.

With this package, a contractor can benefit quickly from polymers, saving time, money, land, and the environment.

More info at www.snf-group.com + www.snf-dredging.com + www.chemistry2011.org

Digging Up Past Glories

Using sonar and a magnetometer, a recent archaeological study of Onondaga Lake has revealed more than 35 wrecks, docks, piers and a fighter jet

The study has been made by the *Lake Champlain Maritime Museum* in Vermont for **Honeywell International** as it prepares to begin dredging industrial contaminants.

The 2.65M yd^3 (2.4M m^3) campaign's expected to take up to five years and will focus on areas near the western and southern shores of the lake, where various companies dumped soda ash production by-products. Honeywell, the successor to Allied Chemical, plans to pipe the contaminated sediments several miles from the lake to a waste bed in Camillus, where they will be buried in plastic tubes. Total cleanup is estimated at $451M.

More info at www.lcmm.org

Dredging For Dolphins

To attract more dolphins and egrets, a mangrove park will be built at Xiamen, a Haicang Bay coastal city in China's Fujian province

The project, which includes dredging, mangrove planting and islet development, will form part of a marine ecosystem improvement project.

Dredging, of 6.66km^2, is expected to finish by the end of this year and, according to marine experts, will provide a larger habitat for Chinese white dolphins and an ideal habitat for egrets.

More info at http://english.xm.gov.cn

Win-Win Swap

The Port of Tampa has reached a deal with Mosaic to transfer dredged materials from its Alafia River berth to one of the port authority's spoil islands

In exchange for placing 320,040m^3 of dredged material at Spoil Island 2D, Mosaic will pay for the design, permits, construction and related costs of necessary control discharge structure improvements on Spoil Island 3D, also owned by Tampa Port Authority (TPA).

It allows Mosaic and *US Army Corps of Engineers* (USACE) to get on with essential maintenance dredging that will keep Mosaic's berth at an adequate operational depth.

USACE is responsible for dredging the Alafia channel and the Mosaic berth, but its deposit areas are at capacity.

Wildlife also wins – the TPA's spoil islands are important refuge and nesting habitats for certain protected bird species.

More info at www.tampaport.com