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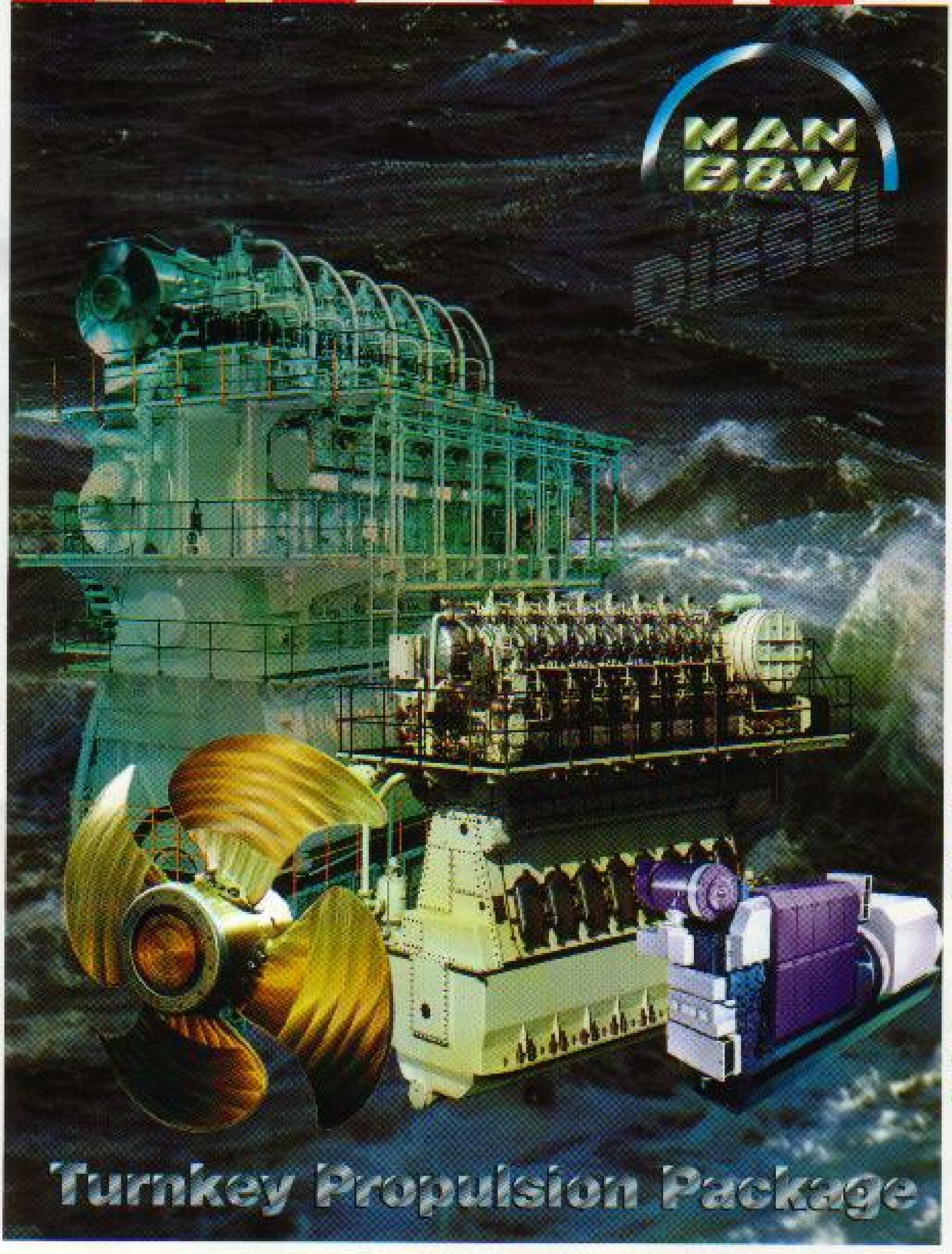

Cargo oil sludge minimised by COW additives

Fuel oil sludge minimised by homogenisers

Shuttle tankers — an evolving breed

Offshore deepwater BOOM!

A new technique for improving the efficiency of crude oil washing (COW) has been tested on an oil tanker by Italian research company MEG. By including additives in the COW system, the company says 330m³ more heavy crude oil was recovered than from a conventional COW procedure, saving US$26 000 worth of products

How additives can make tank cleaning more efficient

Removing tank sludge is an expensive, time-consuming task. While oil tankers are equipped to wash their tanks out with crude oil to remove the sludge, even this method still leaves some sludge which has to be removed by hand before the tanks can be re-filled.

Manual removal of the sludge can be difficult, particularly in single-bottomed hulls, and requires stringent safety procedures.

MEG has patented a novel technology for asphaltenes stabilisation which involves adding chemical additives to hydrocarbons. By keeping asphaltenes dispersed, atomisation is facilitated in that the heavier portions of the sludge are fragmented, leading to an increase in the amount of sludge oil which can be reused.

This theory was recently put to the test onboard the *Agip Lombardia*, an oil tanker which is part of the SNAM fleet. The 113 881dwt vessel can carry 116 630m³ of crude oil in five cargo tanks. Tank washing machines are distributed on one floor and are programmable for the upper and bottom cycles. All the tanks have smooth longitudinal and forward transverse bulkheads; the bottom, deck and central longitudinal bulkheads include obstructions. Each tank has double port and starboard suctions and the stripping line has the same arrangement.

The COW system comprises a pump with a 2000m³/h capacity and 140m head, which supplies 34 Gunclean 270 FTB tank washing machines from Salen and Wicander, with a minimum operating pressure of 7 bar. Each tank washing machine has a flow of about 80m³/h.

A standard cleaning procedure involves the use of COW followed by water cleaning. During the last unloading before dry-docking, the tank bottoms are cleaned using COW in an attempt to remove as much sludge as possible. However, this technique is not completely effective as the tank washing machines guns are unable to penetrate shadow areas where the flow has no direct impact on the sludge. Therefore, after the COW, any sludge left in the bottom of the tank has to be removed manually.

Once the COW has finished, the cargo is completely unloaded and the ship undertakes a degassing trip, where all the cargo tanks are ventilated so manual cleaning can take place. After this the tanks are washed with water, which is then collected in the slop tanks and discharged when in port. After unloading, the slop tanks are then water-rinsed.

Tank number	Tank capacity (m³)	Number of washing machines
1	24 385	8
2	17 179	4
3	25 744	8
4	17 168	4
5	25 447	8
6 (slop)	2X2189	1+1

Tank layout onboard *Agip Lombardia*

In the test, MEG additives were added both in the COW and water-washing phases. In the COW phase, a novel asphaltenes stabiliser, containing a paraffinic solubiliser was added. This product is capable of solubilising existing sludge in a carrier, which, in the case of COW, is crude oil. The sludge becomes stable in its carrier and does not precipitate. Moreover, it is more easily processable, as asphaltenes are no longer aggregated, so the potential for fouling is eliminated.

In the water-washing phase a hydrocarbon solubiliser was added. This product is capable of temporarily solubilising hydrocarbons in water when the two are agitated.

The solubilisation is temporary and, after some minutes, the two phases separate out, leaving the water phase very clear as the additive also helps the separation of the oil from the water.

Neither of these stabilisers or solubilisers contain metal compounds, nor any catalyst poison, nor halogenic or carcinogenic compounds, nor any which, at operating dosages, can poison waste water treatment plants.

In the test, the last cargo the vessel carried before COW was Bouri crude oil, a very unstable crude which can cause severe fouling. First of all, standard COW took place; one upper cycle and two bottom cycles. At the end of these, the slop tank contained 1300m³ of crude and sediments.

One further bottom cycle was performed, this time with the additive which was injected in the suction of the COW pump. After 12 hours of washing, the time it took for all the cargo tanks to be cleaned, the slop tanks contained 1500m³ of crude

Cleaning with additives		Cleaning without additives
Additive in COW	Additive in water	
Parafinic solubiliser	Hydrocarbon solubiliser	200m³ of sludge NOT removed by COW, must be removed manually at a cost of $195 000
Recovered 200m³ more crude oil than when no additives were used	Recovered 130m³ more crude oil than when no additives were used	
Extra 200m³ = 1300bls @ $20/bl = $26 000 saved	Extra 130m³ = 300bls @ $20/bl = $6000 saved	Cost of $96 000 for the four days the ship is not in use while its tanks are cleaned manually

and sediments. Therefore, says MEG, the stabiliser provided for a recovery of 200m³ of sludge oil in the COW phase.

The water-washing phase, also containing its additive, was performed in the same way as the COW, with the water heated to 60°C. At the end of this, a further 130m³ of oil was recovered.

The total amount of extra sludge oil recovered when additives were used in both cleaning phases, was therefore 330m³.

MEG says the economic advantages of using the additives are clear. For example, in the COW phase, the extra 200m³ of crude recovered would make about 1300 barrels of oil, each retailing at approximately $20 each, which makes a saving of $26 000. A further $6000 could be gained from the recovered oil in the water-washing phase.

When not recovered, the owner would have to pay for this excess to be manually removed and disposed of, as tank sludge is considered to be hazardous waste. If it costs around $150/barrel to dispose of the waste, then with approximately 1300 barrels, the owner would be looking at spending $195 000.

In addition, the chemical recovery of the sludge dramatically reduces the time the ship is not in operation. In the case in question, to manually remove the 330m³ of sludge would have cost the ship four days when it could have been operational. Considering a freight rate of $24 000/day, the saving for the shipowner would be $96 000.

The total minimum savings are therefore about $323 000, with a chemical cost of about $42 000.

Both MEG and shipowner SNAM found the tests to be extremely positive and the economics very attractive. Environmentally, the technique was found to be safer and kinder.

* This article is extracted from a paper by Dr Marcello Ferrara, Chairman, MEG, Srl, Messina, Italy.

Another paper, this time given at the recent MariChem97 conference in Germany in December, discusses how to reduce cargo residue to a minimum. In it, Svend Erik Brink of Danish company Svanehoj compares the efficiency of different cargo stripping systems

When MARPOL Annex II regulations, allowing for a residue of 100 litres of cargo to be left in chemical carrier tanks, came into effect in 1987, it was already obsolete, claims Mr Brink in his paper, as most stripping systems could already manage a cargo residue of 20-25 litres.

Almost ten years on, Mr Brink claims there are stripping systems available which could reduce residue to almost nothing, and no more than 5 litres. So how do these systems work?

Assuming that all new chemical tankers have one submerged pump per tank, there are two different kinds of stripping system; an integrated version, which forms part of the cargo pump, and a separate version, usually consisting of an independent pump (piston or diaphragm type) or an ejector-based pressure/vacuum system.

Mr Brink claims that the separate system produces much better results, leaving almost no residue, in comparison with the integrated system which often leaves 20-25 litres residue behind.

The integrated system prevents residue running back to the tank by retaining it in the pump and piping. It is contained using a non-return valve which can be either static or dynamic. Once the liquid is encased, it is blown out using compressed air or nitrogen, usually at a pressure of approximately 6-7 bar.

There are problems associated with dynamic valves, says Mr Brink, as they can blow the liquid ring, produced by the rotating impeller of the pump, if the pressure of the air or nitrogen exceeds that of the impeller. This means that pump and pipe residue are blown back into the tank. Because the cargo pump is not self-priming, the residue cannot be sucked back into the pipe. This problem does not occur with static valves.

With other valves the pump inlet is placed in a sump, usually at the stem of the tank at the lowest place at normal trim. Manufacturers had managed to reduce the residue from 25 litres to almost half that figure by reducing the gap between pump inlet and the sump from 50mm to 15mm.

Even so, this amount could be improved upon using the separate stripping system, believes Mr Brink. By using a separate, or pres-vac system, the residue could be as little as 1-2 litres, depending on the viscosity of the liquid and how effectively the system was used.

The separate system allows residue to run back to the tank with no encapsulating. In addition, the suction branch of the system can be placed just millimetres above the sump bottom.

Both the systems meet levels well below those imposed by MARPOL, concedes Mr Brink, but he stresses that, should the regulations be revised, as is possible, the level should be set to 25 litres, as most vessels are equipped with stripping systems which can meet this. In conclusion, he advises that pres-vac systems should be the preferred stripping system because they are cheaper, more efficient at high viscosities and easier to maintain than the integrated versions.