WATERLINE TANK TECHNOLOGIES

THE TWISTER

Online Tank Cleaning Using the Twister®

PREVENT PROBLEMS INSTEAD OF FIXING THEM

Based on a Panel Discussion at the 35th Annual ILTA Conference

Presented as "The Evolution of Technologies for Cleaning Black Oil Tanks: Part 3 – Online Tank Cleaning", in conjunction with presentations by ExxonMobil and TriStar PetroServe.

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proactive (adj): creating or controlling a situation by causing something to happen rather than responding to it after it has happened

Many changes have occurred in the Aboveground Storage Tank cleaning industry over the last several years, particularly to address safety, health, and environmental issues, in addition to costs. In a nutshell, we don't want to expose people to hazardous environments, we don't want any emissions, and we don't want to generate any waste that we don't have to. Safety is the most important factor in tank cleaning. And everybody wants to get smarter about it and not use the brute-force methods of mining it out or muck-and-suck.

Currently, in a routine black oil tank cleaning, there can be men in tanks, vacuum trucks, dozers, robots, manway cannons with lights and cameras, and in some cases systems sophisticated enough to run NORAD. The costs of a tank cleaning go far beyond those costs. Those direct costs – the invoice paid to the contractor for his people and equipment, and the bill paid to the energy company for the utilities – are far outpaced by the indirect costs – the loss of storage capacity, the loss of hydrocarbon value, and the waste disposal costs.

The way to avoid all of these costs – *the next step in the evolution of tank cleaning* - is to operate in a mode that allows you to **only open a tank and clean it when inspection intervals require it**….say, 20 years….and allowing no other reason to cause a tank opening. And what are the most common issues that prevent these intervals from being reached? Loss of storage capacity due to sludge accumulation; the sludge causing operational problems downstream from the build-up; or damage to the tank floor or shell caused by water trapped in the sludge.

The way to reach this goal – to never have to open a tank "before its time" - is through what we are defining as "*Online Tank Cleaning*". An Online Tank Cleaning approach means the tank must be able to remain in service, and should never have the sludge buildup that requires the sort of manpower and equipment we discussed earlier. Any technologies that require the tank coming out of service don't qualify. Those technologies may be "automated"; they may be "non-entry", but they are still **reactive** approaches, dealing with the problem after it has accumulated. Online Tank Cleaning is **proactive**, preventing the problem from getting out of control in the first place. So we're not talking about becoming more efficient with the cleaning, or only making it safer for the people who have to do it - *the next step in the evolution of tank cleaning* is to prevent the heavy accumulation of tank bottoms and sludge that necessitate the tank having to be opened and cleaned in the first place.

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Online Tank Cleaning is not about simply moving the problem from one tank to another. It doesn't do any good to transfer the problem from the floor of the tank to the pipes and vessels downstream. It is about keeping the solids from building up to a problem level, either by dealing with it on a frequent enough basis that the small amount of solids/BS&W that result can be easily handled through the downstream systems, or else by allowing the solids to build up to a targeted level, and then removing from the system on a periodic basis - *without opening the tank* - say, every 2 or 5 or 10 years.

For a technology to be viable for Online Tank Cleaning, it would have to meet just a few criteria: the technology would have to be capable of being deployed very quickly to be able to be used frequently – perhaps as often as every other week, or quarterly, or multi-yearly, depending on the solids settling characteristics of the product; it would have to be cost-effective enough to allow that pro-active frequency; it would have to be simple to integrate with normal plant operations; and obviously, it has to be able to control the sludge.

So a consideration of available technologies would suggest there are three major approaches that might fit these criteria: use of chemicals; use of side entry propeller mixers; and use of jet mixers. Let's examine each of these approaches against the criteria we've established.

The goal of storage tank managers should be to only have to open and clean a tank when mandated inspection intervals are required.

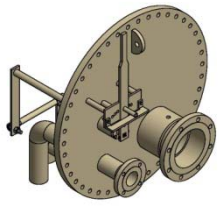
First, chemicals. Some chemicals do a wonderful job of controlling sludge. However, they fail to meet some criteria to be an ideal Online Tank Cleaning technology. They can be deployed quickly. But it is not always practical to use them on a frequent basis. Although they may be cost-effective to use on a periodic basis for difficult tanks like Heavy Fuel Oil, it is not practical to use them on a routine (say, every few weeks or once per quarter) basis on crude oil tanks. They're really designed more for high levels of sludge, and the higher the sludge level, the more cost-effective they become. Second, field operators are not lab techs…results can vary. And some people are concerned that the product or the waste water is being altered. So for all these reasons, chemicals don't seem to be accepted as the total answer.

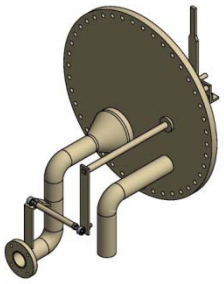
Next, side entry propeller mixers. They are widely used and have a relatively low capital cost, and are easy to deploy. But in general, they have not proven adequate to prevent the sludge…sometimes, they just push the wax and sludge away from the propeller. Often, that is because the HP per bbl recommendations from the manufacturer are not met in real life. That's just a reality. And there are newer versions of propeller mixers that swivel to direct the flow. But there is still a lot of concern about the common seal leaks due to the abrasiveness of the product, and so many operators are removing them from these tough tanks.

So third, we consider Jet Mixers, specifically Submerged Jet Mixers. Today's Submerged Jet Mixers can meet all the criteria we've established….they are simple to operate, can deploy quickly, and use normal pumps, valves, etc. And now, with the advent of the Twister® - the first Submerged Jet Mixer that is very robust against breakdown, foolproof in operation, and low in capital cost - the time has finally arrived to enable the Holy Grail – Online Tank Cleaning.

The goal of the Twister is to deliver a lot of energy beneath the surface of the product in the form of a tightly focused stream that reaches past the radius of the tank, sweeps across the tank, and resuspends the solids. Not all Jet Mixers do that. Some are eductors, which act more like local mixers….say, a shotgun blast vs a rifle shot. Some are manway cannons, which are designed to operate by shooting a jet of water or diesel through the air. Some mixers are not submerged at all….they are fed by a hose through the roof, and have to have a nitrogen blanket to minimize the explosive risk, which is avoided with mixer jets that are submerged – there is no static risk. And some are as complicated as Swiss watches….and subject to grit locking up the unit and, like a Swiss watch, creating an expensive repair. Here's a wish list of what we'd like to see in a Jet Mixer for this application:

- Simple and Safe to operate – the Twister is subsurface, so no nitrogen blanketing required; the operator can tell for sure if the unit is running properly and where in the tank he is jetting
- Cost-Effective to be able to leave on tank so they are always available – the Twister has a low capital cost, and allows for the possibility of temporary rental pumps when they need to be deployed
- Meet design specs of tank: the Twister complies with API650
- Be robust in use for 20+ year life cycle – the Twister has minimal moving parts
- Be simple to maintain and provide contingencies for any failures (e.g., be able to stop a leak) – Fail-safe contingencies for the Twister have been developed
- Require only normal plant operations – the Twister requires no specialized operators or equipment , and you do not have to rely on a 3rd party to activate



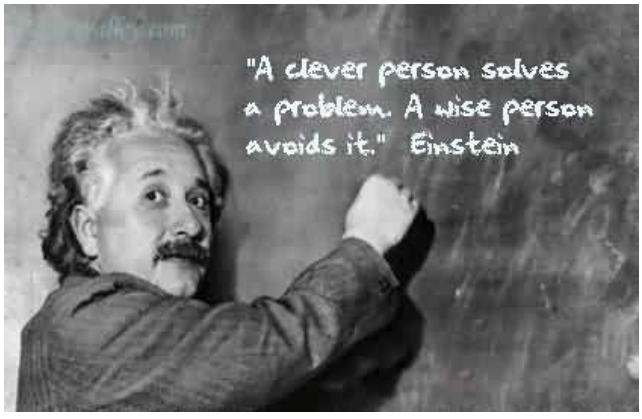


So as you make an evaluation of various mixers that might be considered as Online Tank Cleaning mixers, it may be prudent to compare them to this list to see how they stack up. You can spend a lot of money on mixers and find that you still have to spend a lot of maintenance money to keep them functional. Or you may find that you don't have the flexibility to deploy them at will.

Having Twisters permanently mounted on a tank dramatically shortens the amount of time the tank needs to be out of service for cleaning when inspections are eventually required.

Now, all this discussion has been about Online Tank Cleaning, but this technology has obvious application in shortening the time and improving the safety of conventional offline tank cleanings. Having these mixers installed on a tank permanently also provides the equipment in place to dramatically shorten the amount of time the tank needs to be out of service for cleaning when the inspections (or emergency repairs) are required. Having them permanently installed also avoids having to do something as dramatic as a hot tap to get into the tank. If chemical use is desired, these mixers provide an ideal delivery system - both an entry point for the chemicals as well as the ability to achieve the intimate mixing and good surface contact needed to distribute the chemical effectively. And regular use of the Twister can prevent the accumulation of BS&W, which is known to cause corrosion of tank floor and shell plates.

In summary: the Twister enables Online Tank Cleaning and forms the basis for a Sludge Management Program – allowing you to actively manage the situation, not just respond to it.



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