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RESERVOIR CLEANING - 18 YEARS OF VACUUMING AND REFLECTING

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ABSTRACT

Drinking water storage tank cleaning is carried out to maintain water quality and to monitor the condition of the structure. Many water supply providers now use the diver vacuuming method to clean their tanks, rather than isolate the tank for days and place personnel into confined spaces with the traditional drain and sweep methods. However, few are aware of the actual 'nuts and bolts' of the process. This paper will discuss the equipment used, the hazards encountered, vacuuming methods employed, waste water disposal issues, and the inspection opportunities that are available. After 18 years of reflections (and vacuuming), the author has decided it is time to offer the water industry a 'snap shot' of how this established process can be carried out safely, efficiently and effectively, for both the water provider and the water consumer.

1.0 INTRODUCTION

The vacuuming of tanks began in the early 1990's, and it is difficult to 'pin down' where the original concept began. A need for new processes to overcome an aging work force and the difficulties of placing personnel into confined spaces drove the need to change from the traditional drain and sweep methods. Not having to isolate the tank for days has several other advantages, as pipe breaks are eliminated, consumers are not disadvantaged and reserves of water for fire fighting services are kept in place.

Diving into potable storage tanks has become an accepted maintenance discipline and the process quickly outgrew normal commercial diving practices. This is probably the only type of diving where the water is more at risk from a diver, than a diver is at risk from the environment. Water quality is paramount, so innovations to equipment and a new set of safety rules had to be formulated to satisfy both OH&S and water consumer expectations. Safety has been based on holistic risk assessments and not existing practices, where many diving disciplines have remained unchanged since the 1950s.

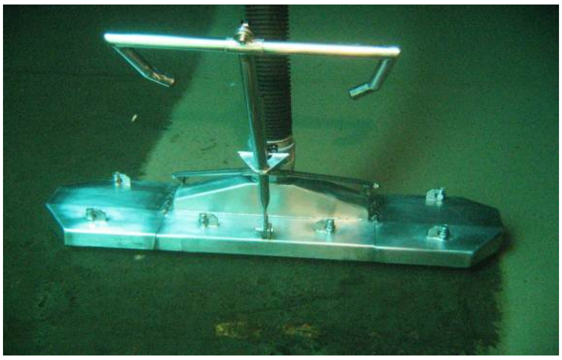
2.0 IN THE BEGINNING

The first task was learning all about water storage tanks – new things to avoid or be aware of. Sharks, Stone fish, boat propellers, strong currents and being too close to the gelignite when you 'pushed the plunger' had to be substituted for small access hatches, ladder cages, unscreened outlets and the many other tank specific hazards that have become apparent over time. Most commercial diving equipment is also heavy and cumbersome, so lifting it all up onto a tank roof some 10 meters off the ground was a challenge. The first tank took around 3 hours to get all the gear set up on the roof, including the umbrella, chairs, thermos and newspaper – after the second job we started to modify and simplify in order to survive physically, as well as mentally!

So after we had a diver in the water, it was….what now? We began vacuuming the floor like it was a swimming pool, with the diver standing in one spot and pushing a long handle attached to the vacuum head. Great progress was being made until the handle broke off one day and the diver decided to finish the job by holding onto the stub end – it was then discovered we could move around 5 times quicker and the diver got to see a bit more of the scenery inside the tank. Cleaning times reduced from 3 days to one day and we thought we 'knew it all' after completing around 10 tanks. Now with over 5000 tanks under our belts, we are completing those initial 3 day marathons in less than 3 hours.

There are three different vacuum heads in use, to cater for large and small tanks, thick and thin sediments, and the 'unexpected' fittings and fixtures within a tank, that cleaning robots struggle with. The wheels are adjustable to allow for 'fine tuning' during cleaning – sticky sediments need the vacuum skirts to be rubbing on the floor and deeper, loose sediments require more clearance to suck up effectively.

Each operator has his or her favourite settings for speed and efficiency and more than one vacuum head is often used during a tank cleaning operation.



Many different types of suction hose have been tried (and discarded) as well – lifting weights have to be balanced with crushing and buoyancy issues. The average sized tank requires 40 to 60 meters of vacuum hose, with larger storages using 100 meters plus, so the equipment vehicles just kept on growing and growing over the years, along with the process knowledge.

3.0 THE MENTALITY

It is important to be 'potable water dedicated' and have the mentality of "if we don't drink it, we don't dive in it". This includes the vehicles, all the external and internal equipment and the personnel. The water industry has spent much time and effort in separating water and sewer operations and this would all be for nought if someone knowingly (or unknowingly) contaminated our drinking water with waste substances. Dry suits and full face masks are a 'given' and there should be plenty of additional suits available onsite to allow for hot and cold weather conditions. Tanks fed from bores have been known to exceed 26° in the middle of winter, so it is not always a 'thick in winter and thin in summer' dry suit policy.

There are no second chances with the pathogen control process. It has to be best practice in all things that we do, because disinfection can only reach the superficial areas of hoses, ropes, dive equipment and storage vehicles. There will always be residual water left in the vacuuming hoses when moving from tank to tank and from client to client, so strict hygiene practices and being particular about where the equipment and personnel have been, are the best options to maintaining water quality and consumer confidence. Disinfection is used as a backup process on equipment, but total reliance on spraying down the diver and whatever bits and pieces of equipment that are within easy reach, is not an effective or fail safe means of pathogen control – it is merely 'ticking a box' and should not be relied upon as the water safety solution.

4.0 THE PROCESS

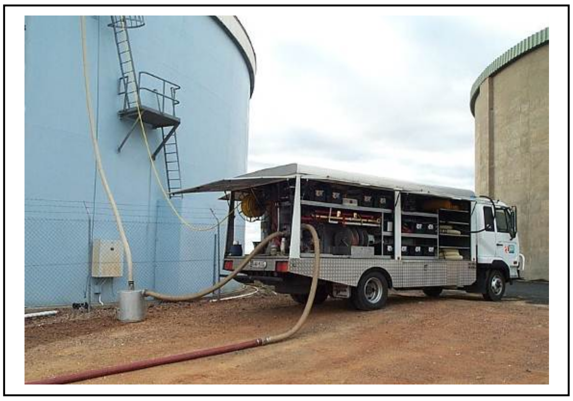
While divers are used to vacuum out tanks online, the process is an holistic combination of water quality trained technicians, height & safety personnel and surface support operators who have the ability to perform difficult manual tasks in all sorts of weather and geographical environments in a safe and professional manner.

The often used saying “we are divers, we are not too smart but we can lift heavy things”, is not applicable in the tank cleaning business. Like all skilled processes, it takes several years to become safe and proficient. More tanks are cleaned by intelligent thinking, than by pushing a vacuum head quickly around the floor. Each tank has a different lay out of posts, pipework and other internal fixtures that need to be considered when an effective vacuum pattern is decided upon. A good pattern creates efficiencies and ensures that no sediment is unnecessarily disturbed or left behind in the ‘hard to access’ areas. Raised floor joints, pipework supports, post bases, ladder platforms and wall floor steps all need to be considered in the cleaning process. Anyone (even a machine) can do the easy bits, but when the vacuum head needs to be lifted over, shifted sideways, blockages cleared away and hoses manoeuvred around within the tank, then the human element is hard to beat.

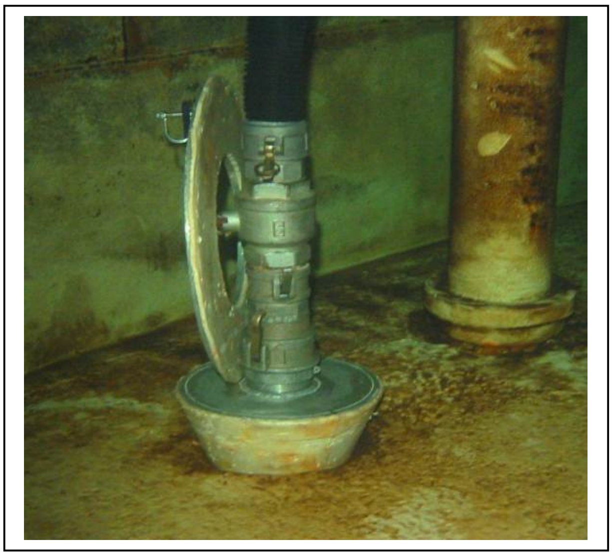
Hoses come in two distinct types – hard hose and floating hose. Hard hose is the tougher working type that can withstand rougher handling without kinking or losing prime, but its weight means it would lay across the floor and disturb sediments. Floating hose is used for the last 20 metres of the system and it allows effective vacuuming patterns to be used without disturbing the floor areas.

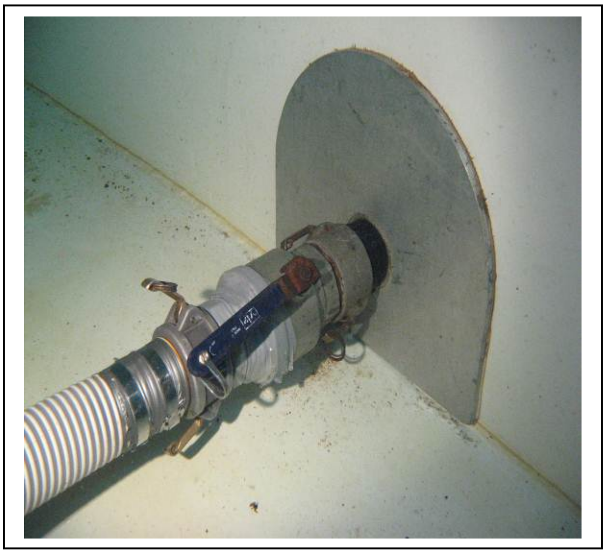
The same applies to the diver’s airline – heavy multiple component hose systems (umbilicals) as used in normal commercial diving situations drag across the floor and disturb the sediments. They are also prone to retaining contaminants and are difficult to clean effectively. For this reason, a single floating airline, with good secure connections has been employed to overcome the weight and pathogen problems. It is easy to deploy and retrieve, it is simple to clean down with a disinfection wipe and it still satisfies the safety requirements of diving in a potable water storage tank.

Good suction is a corner stone of the vacuuming process and this can be achieved in three main ways. ***Pumping over the top of the tank*** – this requires the tank to be at least 80% full for the pump to prime effectively. Using this method ensures that the diver can enter the tank and commence vacuuming straight away. This method is recommended when cleaning a tank for the first time, as scours may be screened, inaccessible or inoperable.



The scour can be utilised to create suction, by placing a plug in the penetration and opening the external scour valve. Various sizes and shapes of scour plugs are carried to cater for most scenarios, however the scour should be close to the diver's point of entry to avoid disturbing the floor area sediments unnecessarily. Deeper tanks often have the water levels reduced to increase the diver's available working time, so the scour method is the only option, when water levels are less than 80%.





On elevated tanks, and having no scour access, a siphon can be created. This is preferable to hanging hard hoses long distances down to a pump for priming. The more heavy hose lowered over the side of a high tank, the greater the chance of a connection failing and causing an incident to the personnel working below. Lighter weight lay-flat hose can be used below the siphon point to run the waste water away.

5.0 WASTE WATER

This can be the hidden component of the pricing process. All cleaning creates waste water and the volumes will vary considerably depending on the sediment types & depth, internal fittings, tank lay outs and how efficiently the vacuuming process is carried out. Waste water can be disposed of in a variety of ways, depending on the tank location – they are listed in order of cost, with tankering being the dearest option:

- Water can be irrigated onto the local ground provided it is assessed as safe to the environment and neighbouring properties are not inconvenienced.
- It can be contained in on-site coffer dams and allowed to evaporate away.
- Waste can be pumped directly to a sewer point if logistics allow.
- Tankers can transport the waste water to an approved disposal site. More than one tanker will be required for continuous vacuuming to be carried out. Waste water is pumped directly into a stationary tanker, and this in turn is decanted into a travelling tanker. This system allows a 40 minute turnaround time to keep up with the vacuuming process. Longer distances will require a second travelling tanker to be employed.

Each option will have a cost involved, but the key to it all is to reduce the waste water volumes – this is determined by the operators experience and on effective vacuuming processes. Reducing pumping flows is a false economy, as vacuuming times are merely increased and the sediments are not lifted cleanly off the floor.

6.0 THE INSPECTION

Vacuuming a tank presents the ideal opportunity to conduct a detailed inspection – the average cleaning time would be 1 to 2 hours, so all the team members (diver included) have time to ‘look, listen and feel’ the key inspection parameters. Removing the sediment means every section of the floor, lower wall areas and internal fixtures have been visually examined at one point or another. There is also no possibility of sediment covering up defects, or of it being disturbed by someone walking/swimming around in an ‘inspection only’ situation.

It is important that all the team members are trained to a technician level and are aware of what to look for while onsite - the ‘fresh eyes’ approach can reveal evidence that would not always be noticed by the day to day operations staff. A structured inspection system will ensure consistent results and allow assets to be accurately compared with each other, allowing for long term maintenance decisions to be achieved.

7.0 THE SUMMARY

The vacuuming of tanks using divers is much more than a diving operation – it is a holistic process involving a mixture of disciplines and technical skills, many of which have to be learned by repetition and trial and error. New safety perspectives had to be developed and tested; equipment had to be modified to overcome working at heights and avoiding water quality risks. Diving had to be re-learned, much the same as caving and extreme depth diving demanded new techniques and outcomes to be developed. There is a certain amount of intellectual property involved as well, so it will be years until formal standards are documented and adopted for all to follow and use. Until then, the existing practitioners will continue to carry out this important maintenance procedure and hopefully all will contribute to our water being (a little bit) cleaner and safer for the consumers to ………consume.