



Corrosion Control for Arizona Department of Transportation Salt Truck Washing, a Case History



The Arizona Department of Transportation (ADOT) was fined in 2006 for discharging concentrated salt water into streams in the Arizona Mountains. Visiting the sites one can see dead pine trees winding down the hillside along the gullies that drain the ADOT maintenance garages. ADOT had previously tried non-salt solutions to snow and ice control but the resulting damage to mountain lakes was unacceptable.

Like everyone that spreads salt, magnesium chloride or other ice control products, ADOT was faced with a serious corrosion problem. Costs due to corrosion to the ADOT salt truck fleet were estimated to be in the millions of dollars per year. Reducing or eliminating this cost was deemed essential and the best solution was to rinse the corrosives off the trucks and implements.

Recognizing that at their remote sites they had no good alternative but to capture the salt water, ADOT went out to industry and asked for a cost effective way to accomplish this.



The Salt Truck Wash System Configuration



In response to the ADOT request, Riveer proposed a comprehensive system to remove and segregate the salt water. The initial Riveer approach was to employ a multi stage filtration system that would ultimately generate salt free water. After processing the wash water through gross particulate filters, media filters and polishing filters, water was processed through Ultra filtration and finally through Reverse Osmosis (RO) filtration. The resulting water was totally pure and salt free. (The total dissolved solids in the final water were less than 10 ppm. At Riveer's plant in South Haven the tap water is just over 200 ppm of dissolved solids).

Other companies have proposed adding water to the recovered water until the salinity drops below a prescribed limit. We can't recommend this; the trees will be just as dead.

These original ADOT systems produced salt free water from wash water. Though an ideal solution to the original statement of work, the difficulty in maintaining the RO and Ultra filter membranes proved too costly and maintenance intensive. As described below, Riveer made several modifications to the system to reduce maintenance and ADOT entered into a PM program with Riveer to reduce the burden on the ADOT personnel, who are typically dealing with winter storm events and working long hours to keep the mountain roads clear. ADOT has had an excellent and trouble free operation since.

In addition to recovery and filtration ADOT was also provided with industrial hot water pressure washers to clean the trucks. These proved to be very effective at removing ice chunks and excess salt.



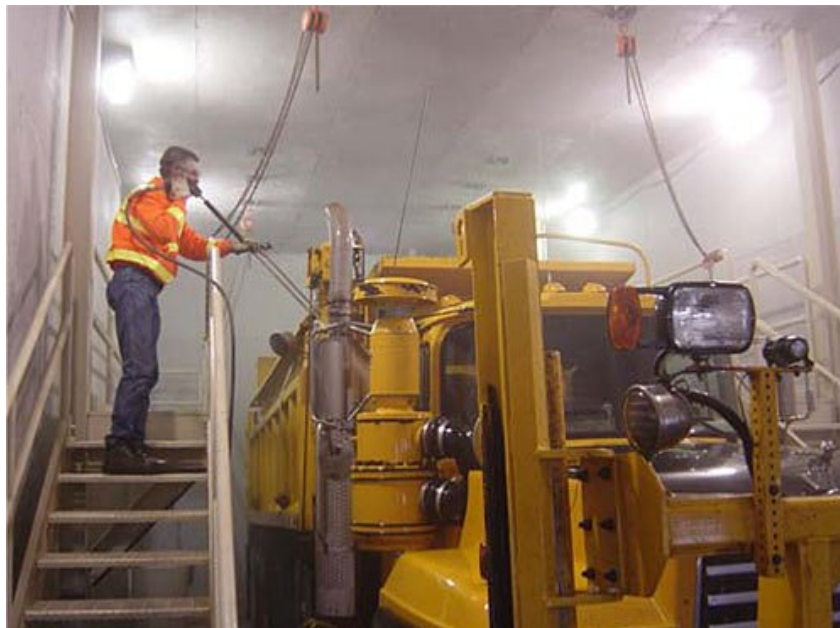
A variety of containment and collection methods were used to suit the needs of different maintenance garages. These included the Riveer Vac-curb, the Riveer above ground steel rack and in-ground trench drains.

To learn more about Riveer filtration technologies click here: <http://www.riveer.com/filtration-technologies.html>.

Field Testing

During post installation testing it was discovered that a salt truck coming in for cleaning could have over 300 pounds of salt caked to it! A lot of this salt comes from loading the trucks in the middle of the night in driving snow storms. Under these conditions it isn't surprising to find that a great deal of salt can get between the hopper and the cab.

Given the high concentrations of salt in the water, the RO units were upgraded to a higher pressure membrane specifically designed for higher salt concentrations. This upgrade allowed the units to process a significantly higher volume of wash water.





Reconfiguration

After the 2nd season of winter operations the systems were further refined to reduce yearly operating costs while still meeting the key goals of not discharging salt to the environment and not hauling waste water for disposal elsewhere.

(In Arizona the DEQ would not allow concentrated salt to be spread back on the roads as they were concerned that the wash water might pick up some heavy metals. Other states have expressly allowed the use of concentrated wash water post filtration to be used in brine.)

The high pressure RO membranes extended the wash water life but even they have a salinity limit beyond which they can no longer process. Rather than fight this limit, the strategy was changed.

Recognizing that the salt water was the primary problem a plan was developed to deal specifically with this waste stream. It was noted that the salinity of the wash water could easily be monitored with electronic salinity sensors. Because the filtration system was controlled by a programmable logic controller (PLC) inputs from the sensors could be used to send water to different tanks as the salinity levels changed. Having worked with ADOT for two full seasons, their washing preferences were well known. Given their tolerance for washing with low to medium salinity water and their preference for rinsing with aggressive (to salt residue) RO water, the system was set up to maximize RO water use in rinsing. To facilitate these preferences, an extra rinse gun was added to the system that was fed with RO water. The wash water was monitored and automatically discharged to a 5000 gallon holding tank* when it hit a prescribed limit.

The RO water was made from incoming well water removing all maintenance issues with the RO membrane.

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It was discovered while monitoring the system that during the course of a typical winter season in the Arizona Mountains, less than 5000 gallons of high salinity water was generated. ADOT had expressed opposition to hauling water from the start. Without the option of dumping the water down the drain, adding it to the salt pile or brine, or hauling it off, the only disposal option left was evaporation. In order to avoid expensive energy consuming evaporators, passive evaporators that used the dry mountain air to evaporate the salty wash water over the Arizona summer were built. It turned out that almost all the water could be evaporated relying exclusively on passive evaporation. Adding a small

Lessons Learned

1. A system that does it all is possible but not practical.

Removing salt from water is done every day at utility scale desalination plants, and on more modest scale on ships. However, the cost and complexity of desalinating the wash water at salt truck washing facilities in real time is not advisable. Alternative approaches can provide comparable outcomes with less maintenance and lower overall cost.



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pump to the bottom of the tank to bubble the tank and break the surface tension of the water, aided the environmental conditions enough to completely evaporate all 5000 gallons over the summer.



2. Intelligent design using local conditions and regulations is the key to success.

In some locations filtered wash water can be added to brine solutions, putting the salt to good use. In some locations high salinity water can be flushed down the sanitary sewer. In some locations the cost to haul salt water is low enough that it is an acceptable solution. A good salt truck wash rack design will take local regulations into account in the equipment design. Given local regulations, the system might be designed to:

- purge to sanitary when pre-set salinity levels are met
- purge to a passive evaporator tank
- employ an active evaporator
- use a storage tank for periodic hauling

3. Use the best tools available.

Though RO is not appropriate for treating the wash water, it should be used to treat the make-up and rinse water. Reverse Osmosis effectively removes all salts from water. Salts are extremely soluble in water and especially soluble in RO treated water where all salts have been removed. The spot free rinse in car washes is RO water. This rinse water grabs all the salts that would otherwise leave white spots on the car. (If you rinse a car with tap water it will have spots on it when it dries). Using aggressive RO water for rinsing the salt trucks removes the residual salt that washing with slightly saline wash water would otherwise leave behind.

Give the operators water cannons and high pressure hot water washers. In some instances the truck drivers have the responsibility of washing the trucks. A 100 PSI @25 GPM water cannon effectively rinses hard to reach places on the truck. If the user doesn't have the right tools, the quality of the water doesn't matter.

Automate the complete system. The users should only interact with the wash guns. The entire system should turn itself on and off from the trigger guns on the pressure washers and water cannons.



4. Plan Ahead.

Incorporating a salt truck wash bay into a new building saves money and allows for integration of the wash bay with the drains, power and gas. Infrastructure upgrades can add significantly to the cost of add-on wash bays.

Designing a concrete wash bay with mechanical means of handling rack salt and ice enhances the performance of the overall system.

Automatic undercarriage rinse can speed up and improve the rinse process.