Significant Cost Savings Attained by Tank Cleaning with Rotary Impingement Technology

Abstract: Specific case studies on the benefits of rotary impingement and CIP optimization vs. the standard tank cleaning processes. Benefits include: increased revenue and production with drastic reductions of operating costs pertaining to tank cleaning.

Tank cleaning has always been viewed as a necessary evil for manufacturers. During the cleaning process, a significant amount of resources (time, chemicals, water, electric, and labor) is required between batches to ensure a reliable, uncontaminated, new batch is produced. Although these repeating expenditures have a significant effect on the bottom line, many manufacturers continue to rely on outdated yet standardized technology for cleaning, not realizing the potential opportunity for substantial cost reductions and revenue recovery through CIP optimization.

To understand how to optimize a cleaning process, one must first understand the basics of cleaning. Herbert Sinner, a former chemical engineer for Henkel, first summarized the basic principals of cleaning in 1959. His summary, now referred to as the Sinner’s Circle, describes the four factors that can be manipulated in any cleaning scenario: Temperature, Chemical Reaction, Time and Mechanical Action. When the effectiveness of any factor is reduced, it must be compensated with the increase of one or multiple other factors. Washing dishes is an effective example of how the four factors interact. Hot water (temperature) is going to remove stuck-on food better than cold. Adding soap (chemical reaction) makes the process even easier, and you can either soak a dish overnight (time) or scrub the dish clean (mechanical action). When cleaning tanks it is imperative to examine not only the effectiveness of the cleaning process but the efficiency as well, especially in such a competitive market.

Sinner’s Circle can be easily applied to tank cleaning as a way to compare the efficiency of processes. The most common tank cleaning processes are: wetting (static spray balls), rotary wetting (rotary spray balls), boiling out, manual cleaning and rotary impingement cleaning. Rotary wetting and wetting are more easily understood as a “cascading method”. By applying massive amounts of cleaning solution to the tank interior, the residue eventually erodes off; therefore resulting in a significant amount of time and effluent consumption and a minimal reliance on temperature and mechanical force (the average force from a spray ball, rotary or static, is approximately .01 lbs). The effectiveness of this cleaning process is accurately described as “fair” often resulting in additional manual cleaning (scrubbing and scraping). Boiling out offers a similar cleaning at an even slower rate, with even more effluent and temperature, and no mechanical action. Manual cleaning, on the other hand, offers a reasonable amount of mechanical force, with minimal effluent, but is time-consuming and the results are not always reliable, due to human error. Also with safety in mind, lower temperatures must be utilized, therefore increasing time.

Rotary impingement cleaning, a newer process, utilizes more mechanical force than any other process, therefore reducing time and cleaning solution drastically.

How Rotary Impingement Works

Rotary impingement tank cleaning machines combine pressure and flow to create high impact cleaning jets. Cleaning occurs at the point at which the concentrated stream impacts the surface. It is this impact and the tangential force that radiates from that point which blasts contaminants
from the surface, scouring the tank interior. In conjunction with this impact, these machines are engineered to rotate in a precise, repeatable and reliable, 360-degree pattern. This full-coverage, indexing pattern ensures the entire tank interior is cleaned, every time. This combination of impact in a controlled indexing manner results in an economic homerun, because impact is a one-time investment; chemicals, temperature and time are continual, never-ending expenditures.

Below are a series of three specific incidences in which rotary impingement tank cleaning was used to optimize an outdated cleaning solution.

**Example 1: Rotary Impingement vs. Boiling out**

A Personal Care Facility located in Memphis, Tennessee utilized a series of 8 storage tanks and process vessels, each with center agitators. The company manufactures a variety of water resistant lotions and experienced severe difficulties in cleaning the tanks between each batch. Their cleaning method included a pre-rinse with DI water, followed by a boiling out process that utilized 864,560 kg of ethanol per year. This is an excessive amount of a very costly solution to ensure effectiveness. By implementing a mobile CIP system with rotary impingement, a more effective and efficient solution was obtained. The company experienced savings in energy, time, and chemicals as well as a validatable and therefore more effective clean.

The process included two Gamajet IX rotary impingement tank cleaning devices. The machines were strategically placed at the top of the tank through a 3” triclover inlet, around the agitators to ensure no areas were missed. The blades were not agitated during the Gamajet cleaning, except for a mid-cycle “jog” to ensure a few potential shadow areas were sufficiently cleaned. The machines were configured to operate at 180 psi and 22 gallons per minute, per device. Based on the residue, this configuration offered the most efficient cleaning for the residue, resulting in 10-15 lbs of force at the furthest distance, the bottom corners of the tank. The machines ran for a 15-minute open cycle pre-rinse to remove the bulk of the residue. Afterward, a 35 minute recirculated wash with a 1% caustic concentrate was run, allowing for the Gamajet machines to make 3 complete 360-degree indexing patterns (meaning every part of the tank was hit three times). This was followed by an un-circulated 10-minute final rinse with the requested ethanol solution. The total cleaning time took 1 hour per tank, an 88% reduction in time. Ethanol usage was reduced by 53%; resulting in a $457,833.00 savings and revenue recovered (based off of a $4,700 per hour tank revenue) amounting to $9.97 million. Additional savings in energy and labor were also experienced but not documented.

**Example 2: Rotary Impingement vs. Manual Cleaning**

Manual cleaning is a very common method, yet beginning to lease some steam. Although nearly every other process is automated, many companies still rely on manual cleaning as an effective way, not only to clean, but to validate the cleaning process as well. Human error aside, no manual clean can ever be absolutely replicated. In addition, margins for error are non-existent. A facility in Philipsburg, New Jersey was utilizing manual cleaning to its fullest extent. The company manufactures a wide range of APIs (Active Pharmaceutical Ingredients) and was experiencing significant revenue loss due to their tank cleaning procedure, and they were under significant pressure to provide a more validatable clean and eliminate confined space entry. Their process included three process vessels, with center agitators, each costing them $9000 in revenue for every hour out of operation. Their cleaning process included five hours of manual cleaning every three days. In addition to the regular cleaning, a 20-hour manual cleaning was performed every quarter. At such a high cost per hour, any cleaning time saved would have a significant impact on
production and revenue. Additionally, a repeatable and reliable pattern would satisfy the sanitarian and result in the elimination of confined space entry for OSHA requirements.

The solution included two Gamajet Aseptic VI rotary impingement tank cleaning devices. Similar to the previous example, the machines were installed at the top of the tank, above the liquid level and around the agitators. No jogging during the cleaning cycle was necessary based on the size of the blades. The machines were powered by a Gamajet-designed CIP System, with a sanitary pump, configured to operate at 120 psi and 20 gallons per minute, 10 gallons per minute per Gamajet device. Due to the nature of the residue this particular configuration offered the most efficient cleaning for the residue, resulting in 7-10 lbs of force at the furthest distance. The machines ran for a 15 minute open cycle pre-rinse, to remove the bulk of the residue, followed by a 30 minute re-circulated wash with a 2% caustic concentrate, and a final 15 minute, un-circulated wash. Based on the design of the machines, the indexing-full-coverage-pattern was completed a total of 6 times throughout the 1 hour wash period. This cleaning allowed for the elimination of quarterly cleaning and a reduction in overall cleaning time by 82%. In addition, 71% less chemicals and water was used and over $5.1 million was recovered in revenue.

**Example 3: Rotary Impingement vs. Spray Balls**

A quick history into spray balls and other “cascading” devices: Spray balls and rotary spray devices are, to this day, the most commonly used tank cleaning devices. Static spray balls were introduced in the 1950’s with the development of CIP. They work in a way that the wash fluid is discharged from numerous holes. This diffuses the energy of the fluid and therefore, impact is minimal, often as little as .01 lbs of force. The cleaning action results in a sheeting or cascading action with minimal impact from the turbulence as the cleaning solution (chemicals) cascades down the tank walls over long durations.

Rotary wetting, on the other hand, is often a rotating spray ball with nozzles or open orifices. The effluent is typically split four or more ways and depending on the manufacturer, high body leakage reduces flow to each nozzle. As a result, impact per nozzle is not optimal. In comparison to spray balls, the randomness of this wetting is limited, resulting in a slightly more exact cleaning pattern, yet still heavily relying on time, temperature, and chemicals. Prior to the development of impingement cleaners, such devices were readily accepted, mostly because there were no alternatives, they were easy to install and inspect, and they provided a better cleaning than the COP process.

Stepping into the latest age of innovation, a major U.S. cosmetic manufacturer could no longer meet the demands of their consumers by utilizing spray balls to clean their tanks. In an effort to avoid plant expansion, the facility turned to the idea of optimizing their process. Although cleaning was not initially on their list to scrutinize, they eventually turned to Gamajet for a possible solution to their dilemma.

The results were much more beneficial then expected. The company, located in Summerset, New Jersey, was cleaning each tank, totaling eight, once a day with 3 spray balls at 60 gallons per minute and 80 psi. Once again with a three inch tri-clover restriction, three Gamajet Aseptic VI machines were installed, operating at the same operating conditions of 80 psi and 60 gallons per minute (20 per machine). Due to the size of the blades and the addition of a “sweeper arm” three Gamajet machines were needed to ensure no shadow areas occurred. The cleaning cycle included a 7 minute half cycle pre-rinse, a 14 minute full cycle re-circulated wash with a 1% caustic
solution, and a final 7 minute half cycle rinse. The complete cleaning cycle took a total of 28 minutes between batches with two complete passes over the entire tank. By decreasing the cleaning time by 69%, the facility was able to increase production at a rate of $3300 per hour, totaling $9.96 million per year. In addition, chemicals and water were reduced by 51%. The payback period was less than one week, versus the potential cost of a new facility.

The above cases are not extreme situations. The evolution of tank cleaning devices has resulted in exponential learning and understanding of cleaning in general. Sanitarians and engineers worldwide have begun to recognize the benefits of rotary impingement tank cleaning and implement them companywide. Today the top personal care and pharmaceutical companies have begun to make the transition, and with ongoing innovation, the pressure requirements for rotary impingement machines has slowly decreased, allowing for them to be a direct trade-out for outdated, less efficient cleaning processes.

For more information or a free consultation please contact Gamajet Cleaning Systems, Inc. With over 70 years of tank cleaning experience, Gamajet is dedicated to providing customers worldwide with the most efficient and effective tank cleaning solutions, offering everything from rotary impingement tank cleaning machines to complete, mobile state-of-the-art CIP systems, all at an economical rate.

Gamajet Cleaning Systems, Inc.
The Tank Cleaning Experts
604 Jeffers Circle
Exton, PA 19341
1-877-Gamajet
Phone: 610-408-9940
Fax: 610-408-9945
Email: Sales@gamajet.com
www.Gamajet.com
If you have a tank to clean, we have a way to do it!