Rotary Impingement Tank Cleaning Equals Significant Water and Cost Savings

Abstract: Specific information and 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 not only to appease FDA standards but to ensure a reliable, uncontaminated, quality batch is produced. Although these repeating expenditures have a significant effect on the bottom line, there are food and beverage manufacturers who continue to rely on outdated yet standardized technology for cleaning, not realizing the potential opportunity for substantial cost reductions and revenue recovery through CIP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 principles of cleaning in 1959. His summary, now referred to as the Sinner’s Circle (See Right), describes the four factors that can be manipulated in any cleaning scenario: Temperature, Chemical Action, Time and Mechanical Force.

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 action) makes the process even easier, and you can either soak a dish overnight (time) or scrub the dish clean (mechanical force). 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 (See Below). 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. This results 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 a “fair” often resulting in additional manual cleaning (scrubbing and scraping). The boiling out method 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 often results in ineffective cleaning, due to human error. Also with safety in mind, lower temperatures must be utilized therefore increasing time. Rotary impingement cleaning utilizes the most mechanical force than any other process, therefore reducing time and cleaning solution drastically. Additionally, a repeatable and reliable result is assured.
Visual Comparison of Tank Cleaning Methods:

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.

Cleaning Method of Spray Balls, Rotary Spray Balls, and Rotary Impingement:
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. Fill and Drain

One of the largest hot dog manufacturers was seeking a solution to the abundance of waste water the facility produced. A majority of the focus was spent trying to alter the manufacturing process, which resulted in minimal savings. Eventually they upgraded their entire CIP process, and the final water savings were staggering.

The company utilized a fill and drain cleaning process to clean a series of four ribbon blenders which were used to mix processed meat. Cleaning was required daily, between each batch. The effectiveness of the clean, when dealing with such meats remained the primary concern. The residue, a buildup of oil and fats, and the series of blind spots due to the tank design, caused even more difficulties for the company to clean. Like most food and beverage companies, their cleaning process proved effective enough, thus the cleaning method remained the same for many years. The process included filling the tanks with water and agitating the blenders. This was then followed by manually cleaning the blades and under part of the agitator as well as any visually missed spots. Total cleaning time resulted in 4 hours per tank, 5,840 hours of downtime per year. The water consumption was approximately 18,000 gallons per tanks, 26,280,000 gallons per year (a cost of nearly $150,000).

After thorough evaluation, it was suggested the company upgrade their entire CIP process, starting with rotary impingement tank cleaning machines.

The new process included a Gamajet steam-operated pump powering five directional Gamajet V rotary impingement tank cleaning devices. The steam pump allowed for the necessary increase in pressure, as well as the hot water needed to clean oils. Steam was also preferred because the plant already had a steady source of steam and the steam pump is highly energy efficient. The pump allowed for the five Gamajet rotary impingement machines to operate at 15 gpm and 120 psi with 180-degree water. The cleaning process included a 5 minute pre-rinse to rid the tank of any bulk residue, a 10 minute wash and then a 5 minute final rinse. This process took 20 minutes for each tank, which was nearly 90% faster than the previous method, saving them 5,354 hours per year. The water usage was reduced by 92%, 1,500 gallons per tank verses the 18,000 gallons per tank previously. This resulted in the savings of 24 million gallons of water per year, and over $100,000 per year, on water alone. In addition, dangerous manual cleaning was eliminated.

Example 2: Rotary Impingement vs. Manual Cleaning

Manual cleaning is a surprisingly common method. Facilities all over the world are grabbing their hoses, pressure washers and scrub brushes, while locking and tagging out, for their CIP process. 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 San Francisco, CA was utilizing manual cleaning to its fullest extent. The company manufactures a wide range of sauces and was experiencing significant revenue loss to their tank cleaning procedure and they were under significant pressure to provide a more validating clean and eliminate confined space entry. Their process included 4 kettles with dual agitators and the sauces were burnt onto the tanks. The cleaning process included 2 hours of manual cleaning every day. The manual cleaning included confined space entry, scraping and scrubbing which had a significant effect on their tank downtime and water usage. The tank cleaning downtime was 2,920 hours per
year and the water usage was 3,504,000 gallons per year which was costing them a total of $16,293.00 per year.

The solution included two Gamajet PowerFLEX rotary impingement tank cleaning devices, positioned precisely around the agitator to ensure thorough cleaning. The machines operate at 90 psi and 40 gpm per machine with 150-degree water, no chemicals. Cleaning includes a 5 minute pre rinse for the bulk residue, a 10 minute re-circulated wash and a final 5 minute rinse. Total cleaning time per tank is now 20 minutes. The pre-rise of 5 minutes is the length of one-half cycle, and testing proved this to be sufficient for cleaning, however in cases where the residue has burnt on longer an entire cycle is requested for cleaning, followed by the final rinse. This ensures that every area of the tank is passed twice, and satisfies the plant sanitarian. As a result, the facility saves 2,434 hours total in tank downtime per year by cleaning 83% faster. They have also been able to lower the usage of water to 2,336,000 gallons per year, saving them $10,861.80 per year. Production was increased by nearly 10% and confined space entry was completely eliminated. (Below are a few photos from testing)

1.1 Baked on fudge and barbeque sauces, on a stainless steel plate, placed 5ft from the impingement cleaner.
1.2 Stainless steel plates after one half cycle at exact operating conditions.

Example 3: Rotary Impingement vs. Spray Balls

Preface:
A quick history into spray balls and other “cascading” devices: Spray balls and rotary spray devices are, to this day, the most common 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 thus results from 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, which still relies significantly 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 provided a better cleaning than the COP process.

Back to our third example: In an effort to establish a more efficient and effective cleaning method, a major food manufacturer, turned to rotary impingement tank cleaning. The results were much more beneficial than expected. The company, located in Mason, OH, operates four continuous production lines, each with 3 tanks. Each day the tanks were shut down for cleaning, which took a minimum of one hour. In many cases cleaning took longer because of regular clogging of the spray balls. There was also additional manual cleaning needed from time to time when the spray balls could not remove the built up residue. The solution was a Gamajet Aseptic VI rotary impingement tank cleaner operating at 115 psi and 15 gpm. Cleaning now begins with a 2 minute pre-rinse to remove the bulk of the residue followed by a five minute re-circulated wash with caustic and a final two minute rinse. The total cleaning time is 91% faster at only 9 minutes. The design of the machine coupled with a filter allows for the debris to pass through or be caught, resulting in no clogging. The facility utilizes the saved cleaning time to increase production by 71%, producing 1,042 batches more per year. In addition the facility reduced its water and chemical usage by 85%.

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 not only to recognize the benefits of rotary impingement tank cleaning but also implement them company wide. Today the top food and beverage companies have begun to make the transition to rotary impingement tank cleaning.

For more information or a free consultation please contact Gamajet, which is part of the Alfa Laval Group. With over 70 years of tank cleaning experience Gamajet is dedicated to providing customers worldwide with the most efficient and effective tank cleaning solutions, beginning in the tank with the residue and expanding outward to a complete, mobile state-of-the-art CIP system at an economical rate.