

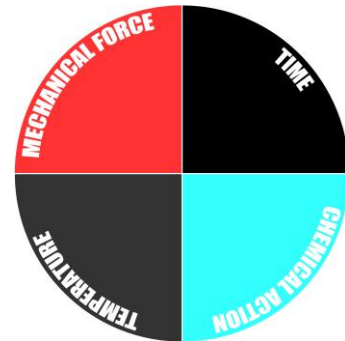
Cost, Time, and Water Savings Gained through Rotary Impingement Tank Cleaning

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 and drastic reductions of operating costs pertaining to tank cleaning.

Keywords: Tank Cleaning, Automated Tank Cleaners, Nozzles, CIP, Spray Ball, Rotary Impingement, Gamajet, Sinner's Circle

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, quality batch is produced. Although these repeating expenditures have a significant effect on the bottom line, many chemical manufacturers continue to rely on outdated processing for cleaning, not realizing the potential opportunity for substantial cost reductions and revenue recovery through CIP optimization.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 (Seen Right), describes the four factors that can be manipulated in any cleaning scenario: Temperature, Chemical Action, Time and Mechanical Force.

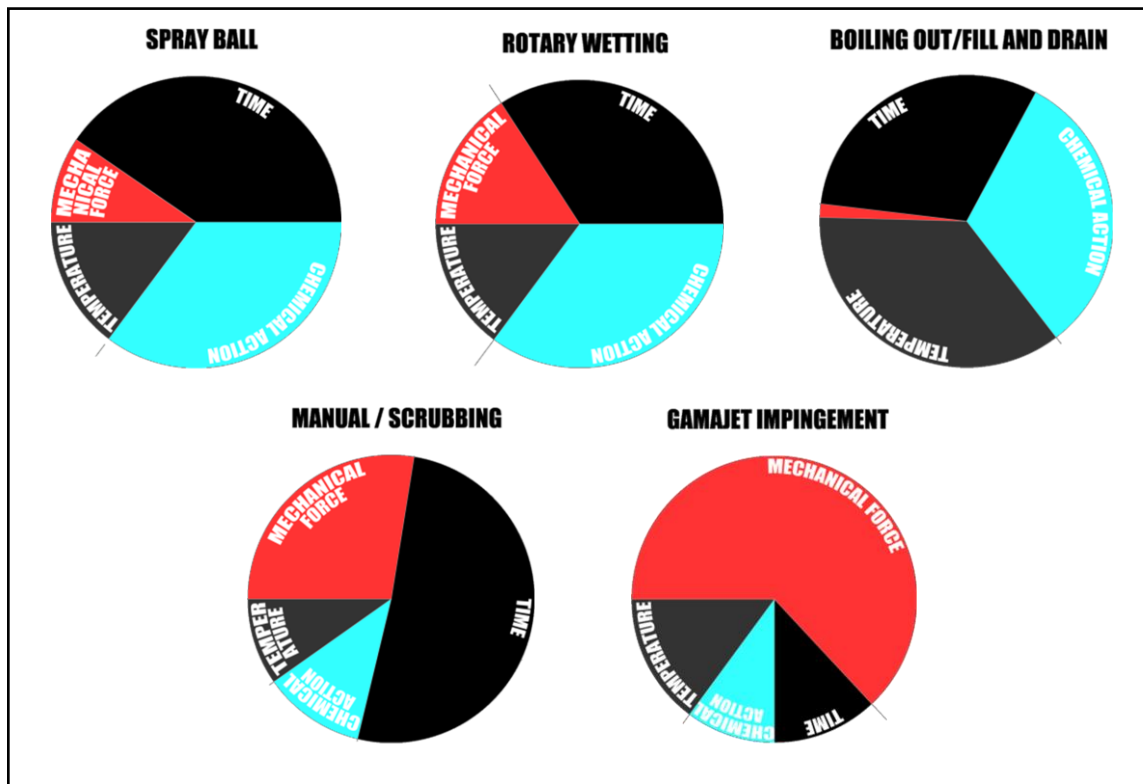


When the effectiveness of any factor is increased, a decrease can occur in one or multiple other factors, without affecting the quality of the clean. Washing dishes is an effective example of how the four factors interact. Hot water (temperature) is going to remove stuck on food better than cold. Adding 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 marketplace. 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, which requires 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

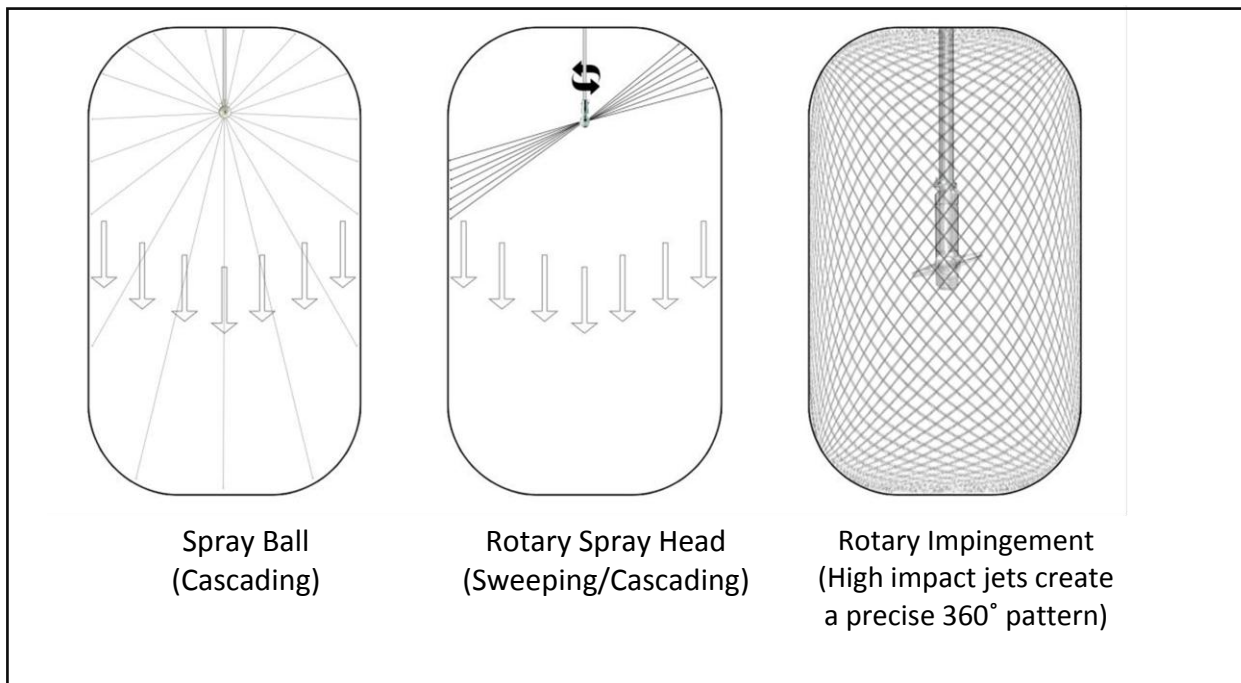
accurately described as “fair” and often requires additional manual cleaning, which includes scrubbing and scraping. Boiling out offers a similar cleaning at an even slower rate, with even more effluent and temperature, and no mechanical action. Manual cleaning, on the other hand, offers a reasonable amount of mechanical force with minimal effluent but can result ineffective cleaning, based on who is doing the job at any given time. Also with safety in mind, lower temperatures must be utilized to clean the tanks, therefore increasing the time it takes to complete the job. There are numerous other reasons why manual cleaning, particularly confined space entry, is considered unsafe. Rotary impingement cleaning, a newer process, utilizes the most mechanical force compared to any other tank cleaning process, therefore reducing time and cleaning solution drastically.

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.



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

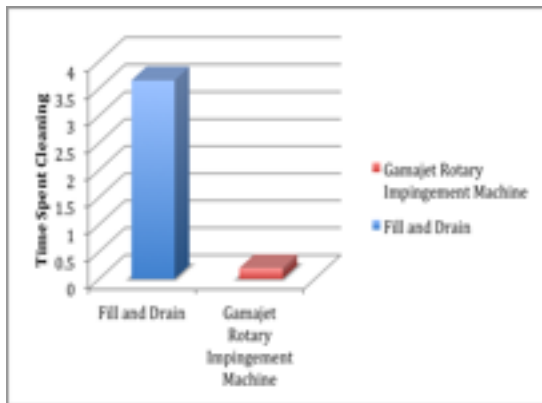
Example 1: Rotary Impingement vs. Boil Out

In an effort to become a more efficient and sustainable business, an Australian specialty chemical company decided to audit their process tanks' CIP process in search for cost savings through time and water usage reductions. The CIP process they utilized was a fill and drain method. As a 24-hour facility, running 7 days a week they were able to make nearly 197 batches per year. Each batch took approximately 44 hours, from start to finish. Of that time, 3.65 hours were dedicated to cleaning. The total process utilized 5800 gallons of water with a caustic concentrate, per batch, totaling nearly 1.5 million gallons per year.

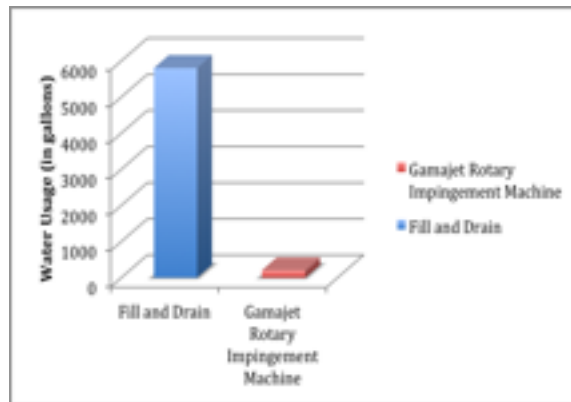
The filling process with hot water and caustic was taking entirely too long for the company to keep up with growing demand. The water usage was also a major concern because of drought conditions, as well as the expense of disposal. An oily residue remained within the internal coils of the reactors after the boil out, requiring additional cleaning.

The primary concerns being time and sustainability, the company introduced a mobile CIP system and a Gamajet rotary impingement tank cleaning device to the process. The CIP was needed to increase the pressure as well as better utilize the heating element. This heat, a necessary component for such residues, coupled with the same concentrate of caustic and significant impact, exceeded all expectations.

Time Spent Cleaning
94.5% Less Time with Gamajet



Water Usage
96.5% Less Water with Gamajet



The solution: The Gamajet impingement tank cleaner required 45 gallons per minute at 100 psi. The nozzle and stator assembly was selected to optimize this cleaning solution, obtaining 15 lbs. of force at a 15' distance. Coupled with hot water and the caustic, the 12-minute cycle time proved to be highly effective. All areas around the coils and behind were thoroughly cleaned, with 205 gallons of re-circulated fluid. Overall the impingement cleaner reduced time and water saving by 95%. The company was then able to increase production by 12.3%, an additional 16 batches. With the pumps running at much less time, energy usage decreased by 277,800 kWh per year, reducing greenhouse gasses by 45,400 kg per year.

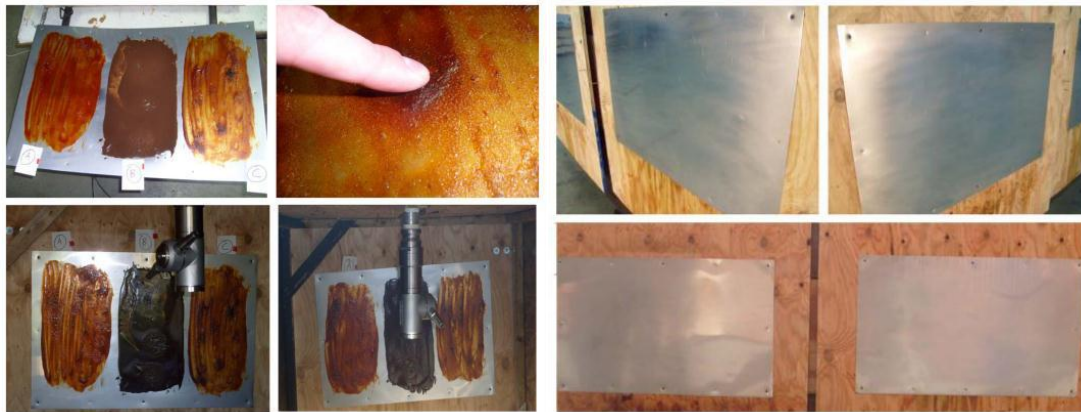
Example 2: Rotary Impingement vs. Manual Cleaning

Manual cleaning is a very common method of tank cleaning; however, the method is beginning to lose 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, the dangers of confined space entry and the potential damage to the tank is high. A facility in San Francisco, CA was utilizing manual cleaning to its fullest extent. The company manufactures a wide range of products and was experiencing revenue loss due to their inefficient tank cleaning procedures, and they were under significant pressure to provide a more validatable clean and eliminate confined space entry. Their process included jacketed tanks with dual agitators and the products were burnt onto the tanks. As a result, their cleaning process included 2 hours of manual cleaning every day. The manual cleaning included confined space entry, scraping and

scrubbing, and a significant amount of tank downtime and water usage. 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 per year.

The solution included two Gamajet PowerFlex rotary impingement tank cleaning devices. These machines were operating at 90 psi and 40 gpm per machine. Cleaning included a 5 minutes pre rinse, 10-minute recirculated wash and a final 5-minute rinse. Total cleaning time per tank was 20 minutes. The PowerFlex was able to give this facility a repeatable and reliable pattern that satisfied the quality assurance manager, and it resulted in the elimination of confined space entry, meeting OSHA requirements. This facility able to save 2,434 hours total in tank downtime per year and was also able to lower the usage of water to 2,336,000 gallons per year saving them \$10,862 per year.

(Below are a few photos from testing)



1.1

1.2

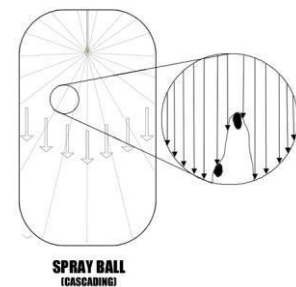
1.1 Baked on products, on a stainless steel plate, placed 5' from the impingement cleaner.

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 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 thus results from sheeting or cascading action with minimal impact from the turbulence as the cleaning solution (chemicals) cascades down the tank walls over long duration.



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.

A chemical manufacturer based in Mason, OH decided to establish a more efficient and effective tank cleaning method because they could no longer meet the demands of their consumers using their existing methods. The company operated 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 the frequent 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 company turned to rotary impingement tank cleaning, and the results were much more beneficial than expected. The solution was a Gamajet Aseptic VI rotary impingement tank cleaner operating at 115 psi and 15 gpm. Cleaning began 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 was 9 minutes, which was 91% faster than the previous method. The design of the machine, coupled with a filter, allowed for the debris to pass through or be caught, resulting in no clogging. The facility was able to utilize the saved cleaning time and increase production by 71%, producing 1,042 batches more a 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. Plant managers, corporate leaders, sanitarians, and engineers worldwide have begun not only to recognize the benefits of rotary impingement tank cleaning, but also to implement them companywide.

For more information or a free consultation please contact Gamajet. 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 mobile state-of-the-art CIP systems, all at an economical price.

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If you have a tank, tote, or vessel to clean, we have a way to do it!