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Implantation System Brine Recover from Some Chemical Treatment Tanks in a Plant Chlor - Alkali

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Abstract

Objectives: This study establishes aimed at recovering the brine flowing with sewage sludge to decrease the concentration of chlorides and reduce salt intake. **Methods/Statistical Analysis:** A piping system taking into account the characteristics of the sludge, which served as the basis for determining the loss of brine in the effluent, make the necessary calculations for the piping systems to develop and to transport the sludge from the point was raised unloading to the recovery site. considered the issue sis sizing based on the measurement of levels, distance the pipe section to place, make the hydraulic study and plans isometric system was developed. **Findings:** With the recovery of brine, it manages to reduce consumption of 7.11 tons of salt daily at the plant, leading to savings of 35,539.6 bolivars per year for salt intake. **Application/Improvements:** When recovering the drained brine the impact this causes for chlorine soda plant, the central plant effluent and receiving water body (Lake Maracaibo) is decreased.

Keywords: Brine, Chemical Treatment Tanks, Chlorides, Sludge

1. Introduction

The production process of Chlor-Alkali part of the brine, a mixture of common salt (NaCl) and demineralized water, which occurs as a major chlorine products (Cl_2), caustic soda (NaOH) and hydrogen (H_2), and other sub products such as hydrochloric acid (HCl) and sodium hypochlorite (NaClO). Plant Chlor-Alkali has area brine, in this one of the processes applied for the ultra-pure brine is chemical treatment, consisting of two tanks stirred reactors, where the brine with coagulating substances that allow the precipitation is of impurities present in the brine as they are calcium and magnesium[1–3].

These precipitates accumulate within the tank forming a sludge, which are then drained from time to time to remove it from the tanks and remove impurities, doing so loss of brine as effluent are generated with a high content of chlorides and sulphates falling freely drainage channel, increasing the concentration in the final effluent, and corrosion on the premises[4–6].

These effluents are sent to the central effluent plant and then discharged to Lake Maracaibo, Venezuela. However for it to be met with the standards specified

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in Decree 883 quality control of water bodies, so to preserve the quality and aquatic habitat species. Because of this increased concentration of chlorides and sulphates in the effluent, it creates a negative impact on the environment, such as salinization of the lake, mortality of marine species.

In order to avoid these problems a system allowing recovery process brine drained through the muds formed in tanks chemical treatment, in order to reduce the concentration of chlorides and sulphates arises, reduce costs salt and corrosion damage, and increase industrial profitability and optimize the overall process.

2. Theoretical Foundation

The brine enters the treatment tank No. 1 E1-TK103, near the bottom and, as it passes through the area of gentle agitation, continue the reaction, the retention time in the treatment tank is 30 minutes at normal flow of 180m^3/hr. The brine treatment tank overflows to Nº-2, E1-TK104. Sodium carbonate solution 15% is added weight. The sodium carbonate reacts with calcium untreated brine to form insoluble $CaCO_3$ (precipitated solid), namely[7–9]:

$$CaCl_2 + Na_2\,CO_3 \text{ ----------> } CaCO_3\,(s) + 2NaCl \quad (1)$$

In practice, add sufficient $Na_2\,CO_3$ to maintain an excess of 0.5 gpl to 0.7 gpl $Na_2\,CO_3$ in the treated brine, ensuring that the reaction be carried to the output side of TH-101 of the product. The value set for the flow rate will be adjusted to achieve this excess. The flow in the E1-TK104 is also an upflow through a gently stirred region, overflowing into a tube going into the clarifier, E1-TH101. The retention time in the E1-TK104 is 30 minutes, to normal flow. Provisions for the co-addition of NaOH solution taken in the E1-TK104, but is TA initially be added downstream. Also, provisions are taken to add a flocculating agent, but it also initially added downstream. Due to abundant accumulation of precipitates in this area, large quantities of sludge that must constantly drain into the effluent pit inorganic U8-PT814, to allow possible optimization and flexibility, the system is generated[10–12].

Sodium hydroxide solution is injected to 12% of weight within the overflow line from the E1 brine-TK104. The sodium hydroxide reacts with the magnesium chloride in the brine untreated, to form $Mg\,(OH)_2$ insoluble (precipitated solid), as follows[13,14]:

$$MgCl_2 + 2NaOH \text{ ---------> } Mg\,(OH)_2\,(s) + 2NaCl \quad (2)$$

In practice, sufficient caustic is added to maintain an excess of 0.2 gpl to 0,30 gpl NaOH in the treated brine, ensuring that the reaction is carried out until the E1-TH101. The value set for the flow rate will be adjusted to achieve this excess (Figure 1).

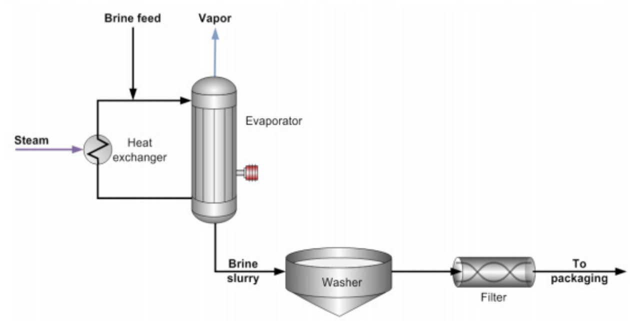

Figure 1. Process chemical treatment[1].

Annual losses of salt in sludge drained from the tk-103/104 tanks of chlorine soda plant

Table 1 shows the values of certain flow rate indicated in each direction corresponding to the output for the current drain tanks:

Table 1. Flow drained sludge in TK-103/104 tanks[2]

Tank	Mud flow (m^3/day)	Total flow (m^3/day)
TK-103	10,758	21.516
TK-104	10,758	

By uniting the flows of sludge generated in the two tanks a total flow of 21,516 m^3/day with a concentration brine 0.6639 Kg, which is drained through both lines, consequently resulting increase in chlorides and sulphates in is obtained final effluent affecting water bodies (Lake Maracaibo). This in turn increases costs taking into account that the brine is treated to bring it to the ultra-pure condition.

In Table 2 shows the main parameters are displayed and determine the importance of this degree thesis, as are the flow rate of the total drained sludge, the amount of salt containing and monetary savings that would be obtained when designing the system recovery to propose in the next chapter[15–17].

Table 2. Savings with brine recovery

Average concentration of brine (Kg / m^3)	663.9
Total volume of sludge drained the TK-103/104 tanks (m^3 / day)	21.516
Drained salt flow (tons)	7,11
Chlorides present in the drained sludge (Ton)	4.44
Monetary savings in consumption of salt ($ / year)	426475.2

With the recovery of drained brine flow through chemical treatment system, the courage of 7,11 tons of salt to the final effluent from the plant, which is sent to the central effluent plant and then the body of water is avoided (Lake Maracaibo). This effluent not only causes serious damage to the body of water being thrown out of specification, if not increasing salt intake in the plant for the production of chlorine, caustic soda and hydrogen and produces the deterioration of facilities of the plant the corrosive effect.

3. Research Results

Among the results it intends to propose a system of pipes and fittings to transport salt muds flowing tanks chemical treatment to the pit recovery sizing system recovery brine and materials to be used as pipes, elbows, valves, etc. are specified in the isometric made to the system, which measures each pipe section, location and position of each of the elements of the system brine recovery in the plant are detailed chlorine soda.

The calculations for the friction factor, speed and Reynolds number for the recovery system brine, it can be observed depending on the flow of currents involved, the Reynolds number is over 4000 (see Appendix), therefore the regime is turbulent and fluid velocities are less than 3 m/s, which represents a reasonable for a fluid distribution system as water, oil and other commonly used in ducts speed[18,19].

It can be seen that both the losses through the pipe h L, as losses through 45 ° elbows h 45° and 90°, h 90°, were respectively low, this is a consequence of the low speed fluid, and a C-PVC pipe whose roughness is negligible by being a plastic material is proposed (Figure 2). Moreover the value of the equivalent length of the diameter of the pipe that are standardized for some accessories in this case the value of 30 to elbows 90° Standards an s and 16 for 45° elbows shown[20–23].

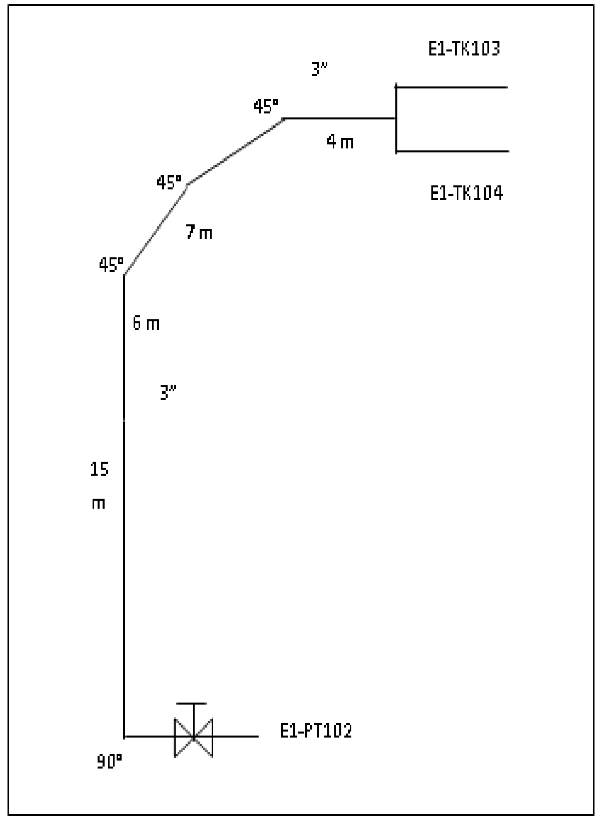

Figure 2. Isometric Pipelines.

4. Conclusions

- Draining the brine streams product precipitation reactions in TK-103/104 tanks produces an increase of chloride and sulfate in the final effluent from the plant.
- The flow of brine is lost as effluent through the drained sludge treatment tanks chemical TK-103/104 is 21.516 m 3/day.
- With the recovery of the brine from the drains of chemical treatment tanks TK-103/104, is achieved chloride concentration decreased to 4.44 t/m3 day in the final effluent it sent to the central plant effluent.
- With the recovery of brine, it manages to reduce consumption of 7.11 tons of salt daily at the plant, leading to savings of 35,539.6 bolivars per year for salt intake.
- When recovering the drained brine the impact this causes for chlorine soda plant, the central plant effluent and receiving water body (Lake Maracaibo) is decreased.

5. References

1. Alphonse Chevallier. Madrid: Printing Manuel Alvarez, Study: Diccionario alterations and forgeries of food, medicinal and commercial substances, with the indication of the means of recognizing, Volume 2. 2005.
2. Ana Beatriz Picado, Milton Alvarez. Costa Rica. Editorial Universidad Estatal a Distance: Chemistry I. 2005.
3. Angel Alonso Garcia. Barcelona. Editorial Marcombo: Concepts of industrial organization. 2007.
4. Cengel Y, Boles M. Mexico: Editorial Mc Graw Hill/Inter Editores, SA de CV: Thermodynamics, Fifth Edition. 2006.
5. Enrique Gutierrez Rios. Barcelona: Editorial Reverte: Chemistry. 2006.
6. Flores Huerta. Editorial Barcelona: Manual, Mimeographed material. 2011.
7. GEA Process Engineering SA (online document). Date accessed: September 2016: Available from: http://www.gea-pe.com.ar/nar/cmsdoc.nsf/webdoc/webb7hgqwu
8. Scott Fogler H. Mexico: Editorial Pearson: Elements of Chemical Reaction Engineering. 2008.
9. Storch de Gracia JM, Tomas Garcia Martin. Madrid: Days editions Santos SA: Industrial safety in chemical plants and energeticas. 2008.
10. John Happel, Donald G Jordan. Chemical Process Economics. Barcelona. Editorial Reverte. 2001.
11. Jose Antonio Jaramillo Sanchez. Madrid: Editorial Mad, SL: Chemistry. 2004.
12. Joseph Oriol. Snore Dictionary industrial and agricultural commercial matters. 2003; 2.
13. Training Manual chlorine soda. Editorial capril: Mimeographed material. 2006.
14. Manuel Aguilar Sanjuan. Barcelona: Editorial Reverte: Introduction to ionic equilibria. 2009.
15. Mario Bunge. Mexico: Siglo XXI Editores: Epistemology. 2008.
16. Martinez V, Alonzo P, Lopez J, Carbajal M and Rocha J. Mexico: Publishers Plaza and Valdez: Process Simulation in Chemical Engineering. 2010.
17. Modeling Processes With electrolyte. Aspen Technology, Inc. Version 10.1 (1981-1999). Available from: http://www.chemengr.ucsb.edu/~ceweb/courses/che184b/aspenplus/GettingStartedElectrolytes.pdf.
18. Nelson Leonard Nemerow, Avijit Dasgupta. Madrid: Days editions Santos SA: Treatment industrial and dangerous discharges. 2010.
19. July Fraume Nestor Restrepo. ECCO editions: Environmental Dictionary. 2010.
20. Nestor Riano Cabrera. Colombia: Editorial Universidad de Caldas: Basic fundamentals of analytical chemistry, Quantitative analysis.
21. Rafael Uson. Barcelona: Editorial Reverte: Chemistry. Experimental science. 2007.
22. Trino Suarez B. Industrial Chemical and Industrial Processes. VI Venezuelan School for Chemical Education Merida, from 05 to 10 December 2004.
23. CPVC Schedule 80. (online document). Date accessed: 2014 May 15: Available from: http://www.iploma.com/12.htm?sessionid=4769930801299326.