

Q. What is the difference between batch and continuous processing?

A. Batch processing recovers acid only when the tank is totally spent. Continuous processing, however, maintains tanks at the optimal level for fast pickling speeds and high product quality.

Q. What concentrations does the system maintain in process tanks?

A. If properly sized, the system maintains process tanks below 6% Fe and returns good quality pickling acid with an average iron concentration between 3.2% and 3.5%. The pickling tanks should maintain an acid concentration around 10%.

Our sulfuric acid recovery system is essentially a 98% recovery process. The losses are mostly carryover to the rinse and any spills that take place. Most of our customers never replace their acid since the contaminants are continuously filtered or removed with the crystals. Each day the sulfuric acid is replenished with fresh acid to make up for the crystals that were removed.

From time to time, the customers pump out their pickling tanks and clean the bottoms or do maintenance on the tank. There is usually a loss of acid at that time, as well. Even then, the majority of the acid is reused.

Q. How is the iron removed from the spent acid?

A. Freeze crystallization is a method of removing iron contaminants from sulfuric acid by lowering the solution temperature which lowers the solubility of iron. Lowering the temperature (and controlling other parameters) allows the iron to crystallize and precipitate. The lowest practical level of iron removal by freeze crystallization is between 3% and 4% iron. Attempting iron removal below 3% is more expensive and impractical due to the interferences of mechanical agitation, energy costs, and the lost benefits of the common ion effect.

Q. Why do monohydrates form on the heat exchangers?

A. As pickle tanks become spent, picklers often increase the concentration of free acid quickly by adding strong doses of concentrated acid in an effort to extend the life of the bath. Unfortunately, continual super saturation of the pickle tanks with free acid results in more frequent coating of the immersion heat exchangers in the pickle tanks and precipitation as a monohydrate crystal in the pickle tank.

With sulfuric acid recovery, pickle liquor is maintained at a consistent operating level. As the system continually cleans acid, it reduces the amount of iron available to become monohydrate. As a result, crystallization in the pickle tanks will lessen.

Since the generation of monohydrate is chemical and temperature dependant, the concentrations of iron, zinc, and acid are not the only factors. The monohydrate generation will also increase greatly as the temperature of the pickling bath increases. In a 10% H₂SO₄ solution, for example, monohydrates will begin to form at around 80°C (180°F). Although the bath temperature may not be this high, the heating zone around the heat exchangers exceeds this temperature. This is why the monohydrate tends to form on the heat exchangers and locations where concentrated acid is injected into the bath. Operating the acid recovery system, reducing the pickling temperature to 65°C (150°F), and controlling the amount of free acid will reduce monohydrate crystallization in the pickle tanks and on the immersion heat exchangers.

Q. How long will the system last?

A. Although any and all components have a real life expectancy, the system itself has an expected life of at least 10 years. Beta has systems that have been in operation for more than 20 years. Individual components can be replaced or repaired as they wear out.

Q. Since the system produces crystals, won't our acid consumption figures rise?

A. The generation of crystals does not increase the consumption of acid. Each ferrous ion associates with only one sulfate ion, so the crystals only reflect the actual removal of spent acid. A very small amount of residual acid actually remains with the crystals as a percent of wetness in the crystals.

We have typically seen at least a 20% reduction of acid consumption after installing an acid recovery system. Many customers see between 30% and 40% reduction in acid use. Since the acid is no longer disposed after it becomes inactive (leaving from 5% to 10% remaining acid), it only makes sense that we dispose of no acid and use less fresh acid as make up.

Q. What markets exist for the ferrous sulfate heptahydrate crystals?

A. The crystals are utilized in the animal feed, fertilizer, and water treatment industries. They are usually sold for between \$20 per ton and \$100 per ton based on shipping costs. The purchaser usually provides the polypropylene 1 ton bags for shipping.

Q. How efficient is the system?

A. A typical Model 20 Sulfuric Acid Recovery System will consume 20 kWh. In Portland, Oregon where the cost of electricity is \$.08/kWh, the cost to process 1,000 liters (265 gallons) of spent sulfuric acid is \$1.50.

The primary heat exchanger chills the hot acid coming into the process as well as pre-heats the regenerated acid returning to the process. The normal return acid temperature is 45°C (112°F), subject to temperature of incoming acid. Little energy is used in heating regenerated acid up to pickling temperature and in bringing incoming acid to precipitation temperature of between 12 and 15°C (55 – 58°F).

On the small and mid-sized systems there is no need for a full time operator. Labor rates vary greatly from country to country so we cannot estimate the labor cost accurately.

Q. Does the system require fresh water?

A. Yes, the system uses water for hot cycles, for cleaning the centrifuge, and for the feed pump. Estimated usage is 5 - 10 gallons per 24-hour day. Water usage will vary if the system is operated continuously or intermittently. Water usage is greater for intermittent operation.

Q. What type of warranty is offered with the system?

A. Beta Control Systems, Inc. warrants all parts and labor for a period of one year after the date of commencement of satisfactory operations of the equipment. If, within the warranty period, any equipment or components fail as a result of manufacturer defect, improper installation, or engineering fault, seller will replace or repair the components at no cost to purchaser.

Q. What is a typical return on investment?

A. Depending upon disposal costs, our customers have recorded payback between 0.5 and 2.5 years. Please contact us to assist you with the preparation of your return-on-investment analysis. We can provide accurate system operating costs and filter replacement costs.

Note on filter replacement: The polypropylene filters in the first step of our process remove solids over 100 microns, as well as oils or grease that might have been brought into the pickle tank on the steel. The filters are usually re-used between 2 and 3 times by hosing with water to remove the solids on the surface. This is done in a plastic barrel, and the solids are collected for drying and disposal. Expect the filters to be exchanged about every 30 - 40 tons of spent pickle liquor processed. Individual filter cost is \$7.50 - \$8.00 USD.



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