Galco Steel Ltd

SPENT PICKLE ACID RECOVERY AND REUSE

AT A GLANCE

This project at a hot dip galvanising plant originally aimed to investigate the feasibility of a an acid recovery process and production of an iron solution more suited for use in the waste water treatment industry in Ireland.

However as a result of the extensive investigations undertaken by Galco as part of this project, an alternative solution has been implemented which is in fact further up the waste prevention hierarchy. Increased analysis of spent pickle made Galco more aware of the chemistry of their process and they are now moving to implement simpler solutions which will improve the quality of their spent pickle.

Galco is implementing modifications to produce a spent pickle by-product which will be more acceptable for use in municipal waste water treatment plants. The steps involved will be:

- Implementing acid degreasing, replacing the current caustic degreasing system, giving reduced sludge and better pickling efficiency.
- Pickling at a higher temperature giving a lower acid solution with a higher iron content (increased energy use is compensated by reduced energy use in the degreasing step).
- Adding iron oxide to the spent pickle in a controlled reaction to boost the iron content and reduce the acid content of the pickle.

In Galco's new plant, zinc will be practically eliminated from the spent pickle through the design of the plant equipment and layout. This is a classic case of cleaner production - i.e. do not create a waste stream in the first place.

Galco has continued cleaner greener production work in other areas – water usage has been reduced throughout the plant by 36% between 2005 and 2006 (about 3000 m^3) through increased controls and collection and reuse of drips and spillages.

GALCO STEEL LTD

Galco Steel Ltd. is the largest hot dip galvanizer in Ireland with plants located in Dublin, Cork and a recently acquired plant in Waterford.

Photo 1 Galco Steel's Dublin site

Galco Steel Ltd employs approximately 180 people between Dublin and Cork. The Dublin site has 2 galvanizing baths and the Cork site has one bath.

Galco are in the process of establishing a new plant at Kilcock, Co. Kildare.

AIM OF THIS PROJECT

Hydrochloric acid is used as a pickling solution for steel, i.e. it removes rust, prior to galvanizing. During the process the acid is consumed and the iron content increases until the solution is no longer suitable for pickling.

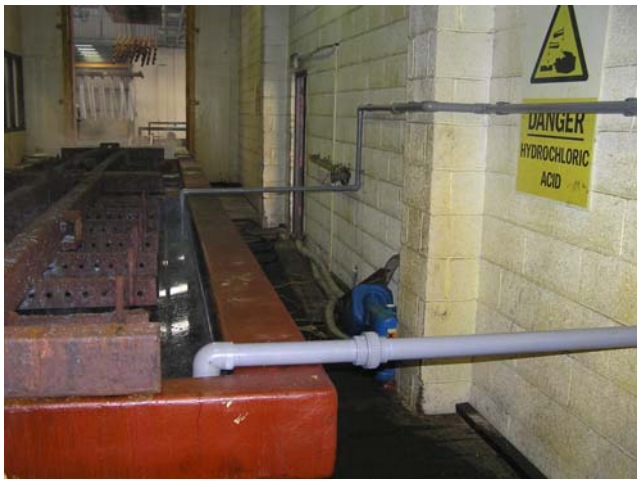

Photo 2 The Pickle tank

Traditionally, spent pickle is sent for use in waste water treatment plants for phosphate removal. However there has been a growing trend away from use of spent pickle in favour of bought-in ferric chloride which has more iron and is less acidic than spent pickle. This has required galvanizers to export the spent pickle for treatment and disposal.

The aim of this project was to investigate the feasibility of a recovery process to recover and reuse hydrochloric acid from the spent pickle and produce a concentrated ferric chloride solution more suited for use in the waste water treatment industry in Ireland.

PROJECT DESCRIPTION

The technical feasibility of various possible options was carried out and those technically feasible were costed. A specification was developed for a saleable ferrous chloride by-product. Detailed mass balance and payback calculations were carried out on four different processes. However none were deemed feasible.

Photo 3 Microfiltration pilot plant

Pilot plant microfiltration trials were carried out on site to investigate cleaning up the spent pickle and extending the life of the pickling bath. While the trials showed some benefits in terms of water use, acid use and waste reduction, costing showed it to be commercially unviable.

In any case Galco at this stage of the project was moving onto investigating why the pickle bath was becoming spent in the first place.

Due to the extensive analysis carried out during the project, Galco identified excessive sodium in the site's spent pickle. The source was identified as carryover from the caustic degreasing process that Galco uses prior to pickling. This causes a reduction in the ferric chloride ($FeCl_2$) generated and an increase in the ferric hydroxide ($FeOH_3$) which forms an insoluble sludge in the pickling tanks. As a result of this finding, Galco is implementing a change to acid degreasing to eliminate this problem.

Apart from the advantage of less sludge forming in the pickling tanks, the acid degreasing step can be performed at a lower temperature than caustic degreasing.

Another improvement identified was to pickle at a higher temperature. This allows the pickle to continue to be used to a lower acid concentration before becoming spent. Therefore the acid solution will be used more effectively and will require less top-ups saving on acid and water use. This increased energy use is compensated for by reduced energy use in the degreasing step.

Laboratory trials of iron enrichment of the spent pickle show that the iron content can be significantly boosted by adding iron oxide, while acid content is greatly reduced. Comparison with a commercially available product was made. Pilot scale trials are to be carried out in conjunction with the local authorities to achieve an optimum level of iron oxide enrichment.

Galco's original aim was to investigate the feasibility of a recovery process to recover and reuse the pickle acid and produce a concentrated solution more suited for use in the waste water treatment industry. However, the solution ultimately implemented differs from that originally envisaged, taking steps to actually prolong the life of the pickling bath in the first place.

As a result of the increased awareness of the major difficulties in removing zinc from spent pickle, the material flows at Galco's new plant in Kilcock have been designed so that zinc will no longer be a major constituent of the spent pickle and will thus be more useful for the end users in the water treatment industry.

The material flows at existing plants in Ballymount, Cork and Waterford are also being reviewed to minimise zinc in the spent pickle.

ACHIEVEMENTS

The full environmental impact of the changes currently being introduced in Galco have not yet been quantified, however there will be improvements in the following areas:

- Zinc reduction at source - in the new plant there should only be minimal zinc content in the spent pickle.
- Reduced acid and water use due to pickling at a higher temperature.
- Extended productivity from pickling acid, less sludge for disposal.
- Less tankers off-site for disposal, tankers that are going off-site will only be within Ireland, not for export.
- Spent pickle will be of improved quality having lower acid content and higher iron content as a result of pickling at a higher temperature and iron enrichment.

OBSERVATIONS

Working directly with the waste water treatment industry to develop an acceptable product has proven beneficial to both parties.

Galco has carried on its work in the area of cleaner greener production by implementing measures to reduce water use throughout the plant, Measures implemented include:

- Strict controls on the use of water by locking off hoses used for topping up acid tanks. There had been wastage due to over filling tanks.
- Installation of a catch tray system around tanks with associated piping and holding tanks to collect and reuse drips and spillages.

All of this led to a drop in water usage of 36% between 2005 and 2006 (about 3000 m^3) and an associated drop in waste water requiring treatment and disposal.

LESSONS

The work carried out in the project, together with detailed discussions with many vendors and others in the galvanising industry has increased Galco's understanding of the chemistry of the existing pickling process, its limitations and what needs to be done to take it to a stage where a valuable by-product can be produced.

The project also illustrates a classic cleaner greener production situation where what is first through to be the most appropriate solution (in this case, a process for recovery of the acid), upon investigation may not actually be the best solution (in this example, finding out what causes the acid to become spent in the first place and making changes to the process to remedy this).

MORE INFORMATION

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CLEANER GREENER PRODUCTION IS…

the application of integrated preventive environmental strategies to processes, products, and services to increase overall efficiency and reduce risks to humans and the environment.

- Production processes: conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes
- Products: reducing negative impacts along the life cycle of a product, from raw materials extraction to its ultimate disposal.
- Services: incorporating environmental concerns into designing and delivering services.

CLEANER GREENER PRODUCTION REQUIRES…

new attitudes, better environmental management, and evaluating available technology options. We need to take good environmental practice to the stage where it is an inherent part of any business operation.

HOW IS CLEANER GREENER PRODUCTION DIFFERENT?

Much of the current thinking on environmental protection focuses on what to do with wastes and emissions after they have been created. The goal of cleaner, greener production is to avoid generating pollution in the first place. This means:

- Better efficiency
- Better business
- Better environmental protection
- Lower costs
- Less waste
- Less emissions
- Less resource consumption

WHY IS THE CLEANER GREENER PRODUCTION PROGRAMME BEING RUN?

The Irish Government, through the National Development Plan 2000 - 2006, has allocated funds to a programme for Environmental Research, Technological Development and Innovation (ERTDI).

The long-term goal is to ensure that cleaner, greener production becomes the established norm in Ireland. The programme seeks to promote environmentally friendly business through increased resource productivity, waste reduction, recovery of materials, improved efficiency in a product value chain, energy management, and a change of culture within organisations.

The programme aims are focussed on avoiding and preventing adverse environmental impact rather than treating or cleaning up afterwards. This approach brings better economic and environmental efficiency.

WHERE CAN I GET FURTHER INFORMATION?

This case study report is one of the reports available from the companies that participated in the second phase of the Cleaner Greener Production Programme. A summary of all the projects and CD containing all the reports are also available.

More information on the Programme is available from the Environmental Protection Agency

Dr Brian Donlon,

Environmental Protection Agency,

Richview,

Clonskeagh,

Dublin 14,

Ireland

Or their website www.epa.ie, by selecting the link to cleaner production.

PROGRAMME MANAGERS:

The Clean Technology Centre (CTC) at Cork Institute of Technology has been appointed to manage the programme.

The CTC was established in 1991 and is now nationally and internationally regarded as a centre of excellence in cleaner production, environmental management and eco-innovation across a range of industrial sectors.