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New Treatment Process for Chelating Industrial Waste Water

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A New Decontamination Process for Treatment of Highly-Complex Effluents

The Company Färber & Schmid, based in Dietikon, Switzerland and Stuttgart, Germany, have unveiled a new process, known as Oxichem for treatment of effluents containing trivalent chromium complexes and other extremely stable metal complexes,

Chromium (III) complexes

Reflecting the increasingly severe legislative pressures governing hexavalent chromium compounds, there has been growing use of trivalent chromium electrolytes for decorative electroplating of that metal. Within this category, however, there are many different electrolyte compositions. Instead of chromic acid, a range of chromium (III) compounds are used with electrolytes based on either sulphates or chlorides. The pH values of such baths lie in the range, depending on the bath in question, between 2.5 and 4.0 and are stabilised by addition of organic acids which act as complexing agents.

These organic hydroxy-acids (for example malic acid) increasingly result in practice in massively exceeding the allowed maximum concentration of chromium-containing species in effluents. Given its two carboxyl radicals and one hydroxyl grouping, malic acid readily forms chelate type complexes. The first such stable complexes with Cr, Ni or Cu begin to form above pH 2.5. Compliance with the required legislative value of "Total Chromium content" of 0.5 mg/L for such effluents is extremely difficult and in many cases impossible, with effluent treatment processes currently available. The effluent treatment processes currently used for such effluents are in most cases simply unable to meet the new, more demanding, concentration limits! With a growing number of customer problems arising from this situation, a range of treatment options were trialled, aimed at addressing this serious problem. The new decontamination process resulting from this work, known as Oxichem, is simple to use and eco-friendly and allows users to treat chromium complex-containing effluents efficiently and safely while meeting prescribed concentration limits.

Other Metal Complexes (Ni, Cu Zn ….)

A wide range of extremely obdurate and stable metal complexes such as nickel-cyanide, copper-EDTA, zinc/nickel polyamine compounds and others can be broken down with their metal constituents reliably precipitated, using the Oxichem process. Contradicting the theory that such problematic compounds should never be found in effluents, these metal-complexes can be formed by process operating conditions such as dragout from rinsing stages or insufficient separation of effluents streams. Given that the stability constants of such complexes are often >20, existing effluent treatment processes are in most cases unable to break down such compounds. By contrast, the new Oxichem process, can be successfully used to treat the widest range of effluent compositions while meeting the desired concentration outcomes, noting that in most cases these parameters will be customer-specific.

Case Studies

Example 1

An electroplating business converted a number of bright chromium plating lines from hexavalent to trivalent electrolytes. Thanks to additional water-saving measures, effluent volume was reduced by 30 %. As a result, species present in the effluent as well as the ratio of their concentrations, were significantly changed. Using the treatment methods previously employed, chromium concentration values in the treated effluent failed to meet the required levels. Chromium concentration levels of 15 to 20 mg/L using the older process were often recorded and only with considerable additional operator time and multiple treatment of such effluents, could the required limits be met. Additional expense was incurred because some effluent processing had to be undertaken by an external contractor. Since employing Oxichem technology, the customer has no difficulty in conforming to chromium concentration limits on a sustainable basis. Typical chromium concentration values are averaging 0.2 mg/L.

Example 2

As a result of cross-contamination caused by dragout from a cyanide-based process, a jobbing electroplating business encountered serious problems resulting from formation of nickel-cyanide complexes. In spite of making every effort to control the discharge concentration of nickel, levels of less than 5 mg/L could not be achieved. Every possible method from strongly acidifying the effluent to use of organosulphides was tried without success. Only by use of the Oxichem process could the prescribed concentration limits be met. After the new process was installed, average nickel discharge values were < 0.5 mg/L.

Example 3

Following increased use of EDTA-based electroless copper solutions by a contract plater, the company was faced with problems arising from formation of extremely stable nickel metal complexes formed in the effluent as a result of unavoidable cross-contamination. Effluent analysis revealed that nickel concentrations could not be reduced below 7 mg/L. This was the case notwithstanding use of unsustainably large amounts of treatment chemicals and extension of treatment times in the previously used effluent treatment method. Now, after introducing Oxichem, all metal ion discharge concentration limits can be met without difficulty, and without overlong treatment times.

Processes

The Oxichem process is based on the coordinated use of a range of individual products, as each situation demands. These include OXI-74, OXI-75, OXI-76 as well as OXI-76/MME. Effluent treatment using one or more of these compounds is prescribed on a customer-specific basis. Depending on the requirements and the complexity of the effluent in question, the treatment sequence is customised to ensure the most efficient and cost-effective solution.

OXI-74 is designed to achieve splitting of complexed heavy metals allowing even strongly-bound complexes to be broken down. At the same time, TOC values are reduced.

OXI-75 is used as a decomplexing agent. The metal ions thereby released can thus be removed from the effluent. Simultaneously, this product serves as a clarifying agent, working as a coagulant where oils, surfactants and emulsifying agents are present in high concentrations.

OXI-76 is an environmentally-friendly and highly efficient heavy-metal precipitating agent. Thanks to its unique properties, it has a very high acid stability (pH 3.0) and very low eco-toxicity (Category WGK 1). Odour problems are extremely minimal and any excess of unreacted reagent causes no problems of eco-toxicity. Selective ion exchange resins used for polishing are not damaged by OXI-76. This specialised product will precipitate all commonly encountered metals including Zn,Ni, Cu, Ag, Au, Sn, Pb, Hg and As individually or simultaneously, transforming them into inert and stable residues.

OXI-76/MME is mainly recommended for precipitation of nickel-containing complexes and has been specially optimised for this task. It also ensures efficient and safe precipitation of all other metals treatable using OXI-76.

Separation and dewatering of precipitated sludges, following flocculation, for example using the ZetaPol range of products, can then be carried out using a chamber filter press.

Summary

Thanks to the use of increasingly sophisticated electrolytes for electrodeposition of metals and in some cases, alloys, coatings with exceptionally high corrosion resistance are obtained. However the difficulties in treatment of effluents from such processes have enormously increased. The new Oxichem process offers a solution to such problems where previously used reagents and processes failed to achieve a reliable and satisfactory result or where satisfactory effluent treatment can only be achieved with inordinately demanding measures.

The Oxichem process guarantees a totally clear supernatant effluent phase, a superbly dewatered sludge as well as ensuring compliance with legislatively prescribed metal ion effluent concentration limits. It can reduce or even completely eliminate bottlenecks caused by overlong treatment times. In a word, Oxichem offers a solution to virtually every effluent treatment problem. -Felix Schmid-

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