Environmental Catalysts

ACCENT™

Innovative technology for water and waste water treatment
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The **ACCENT** process from Johnson Matthey Catalysts offers, for the first time, a fixed bed catalytic technique to remove organic contaminants (pesticides, colour, non-biodegradable organic species, etc.) from aqueous streams. It combines high performance with low operating costs, thanks to its unique design. Patents for the catalyst and process have been granted in several countries.

**Uniquely meeting its market’s needs**

Although the trend is towards chemical destruction processes, many available technologies are not applicable to most industrial effluent streams. There is also limited choice for low levels of COD (100-5000 ppmw) and low flow rates.

In contrast, any industrial process where organic species in aqueous waste streams cause problems is a potential user of the **ACCENT** process. It can be applied to both continuous or batch processes in industries such as: bulk/intermediate/effect chemicals, agrochemicals, pharmaceuticals, petrochemicals, textiles, pulp and paper, soaps and detergents, dyes, synthetic resins, petroleum refining (spent caustic treatment), adhesives, pigments, rubber chemicals, food and beverages.

**Main process features**

You can employ the **ACCENT** process for catalytically enhanced chemical oxidation in stand-alone, pre-treatment or post-treatment roles. There is also a recycle option. It is readily integrated into your existing set-up and is upgradeable, with guaranteed options for exit hypo concentrations of less than 10 ppmw. Fully automated control is available, incorporating self-optimization.

You can be sure of optimum selectivity, low levels of hypochlorite and continuous effluent monitoring. Catalyst performance is guaranteed.
ACCENT and traditional solutions

A number of traditional aqueous effluent treatment technology options exist for the removal of problem organics.

- Ozone or hydrogen peroxide treatment
- Thermal and catalytic incineration
- Wet air oxidation
- Biological treatment
- Fentons catalysed peroxide reaction

Each has its own particular strengths and weaknesses, but choosing the correct technology is not always easy. The starting point should always be to analyze and measure the contents of the stream to be treated. This, together with the volume and degree of treatment required, will have a profound effect on the choice of technology

The benefits of ACCENT

The ACCENT process offers selective heterogeneous chemical oxidation, minimizing the use of oxidant. Because operating costs are dominated by oxidant cost, if waste hypo is available, these costs are considerably reduced or eliminated. Simple and robust, the ACCENT process is easy to operate under mild conditions and highly reliable. Savings in operating costs, coupled with lower capital, maintenance and labour costs can result in a 40% cost advantage.

Compared with conventional technology, the ACCENT process:

- operates over a wider range
- there is no sludge
- controllable oxidation allows partial or complete COD removal or simple deodorization or decolorization
- the organics are converted to environmentally friendlier components

As shown in the technology map, ACCENT in stand-alone mode is best suited to comparatively low COD duties. The ACCENT technology segment can be extended horizontally if the TOC is reduced and can be extended vertically if the flow is reduced. The range of application can be extended by using the process in pre- or post-treatment combination with existing technologies.
How does ACCENT work?

The basic chemical reaction utilizes a catalyst to convert sodium hypochlorite to brine and a highly reactive oxygen atom held on the surface of the catalyst (reaction 1). This oxygen species is responsible for the enhanced oxidation of organic contaminants in an aqueous stream. The transformation of the catalyst surface producing an adsorbed oxygen species provides a powerful medium capable of oxidizing almost any organic compound (reactions 2 & 3). Reaction 3 represents multiple oxidations to mineralization.

The reactions taking place over the catalyst are summarized and shown diagrammatically below.

**Reaction 1**

\[ \text{NaOCl + CAT} \rightarrow \text{CAT} \oplus \text{O} + \text{NaCl} \]

**Reaction 2**

\[ \text{ORG + CAT} \rightarrow \text{ORG} \oplus \text{O} \rightarrow \text{ORG} \oplus \text{CAT} \]

**Reaction 3**

\[ \text{ORG} \oplus \text{O} + \text{CAT} \rightarrow \text{CO}_3^{2-} + \text{H}_2\text{O} + \text{CAT} \]

The process is known as Catalytically Enhanced Hypochlorite Oxidation or, more broadly, Active Oxygen Transfer Catalysis. Although prevailing economics favour sodium hypochlorite, the oxidant may also be supplied as hydrogen peroxide or other active oxygen supplying oxidants. The promoted nickel oxide catalyst holds active oxygen on the catalyst surface and also acts as an adsorbent for organics (e.g. R above) and COD (Chemical Oxygen Demand) from the aqueous stream.

![Schematic reaction on catalyst surface](image)

![Rate enhancement of destruction of ethyl acetate](image)
Commercially proven technology

This innovative process has been proven in successful laboratory trials on customer effluent samples, pilot-plant studies at customer sites and commercial (full scale) installations.

Laboratory studies

These have shown the ACCENT process successfully oxidizes a wide range of organic compounds including:

- refinery spent caustic treatment
- alcohols
- aldehydes
- carboxylic acids
- sulphides
- olefins
- aromatic and cyclic hydrocarbons
- ketones
- phenols
- ethers
- amines
- carboxylates
- chlorinated and other substituted hydrocarbons
- pesticides
- herbicides

The effect of space velocity (SV) on organic acids removal rates at 30°C

Typical destruction of organo-chlorine compounds

TOC – Total organic carbon
TON – Total organic nitrogen
Pilot-plant studies

Johnson Matthey Catalysts has investigated generic effluents from process industries at both laboratory and scaled-up on-site pilot-plant testing, enabling us to predict the selectivity and therefore viability for a particular effluent stream. At pilot-plants at a number of customer sites, ACCENT has demonstrated its success at eliminating non-biodegradable organic compounds from chemical, agrochemical and pharmaceutical manufacturing waste.

The experimental results indicate the degree of treatment achievable and allow an estimate to be made of the catalyst volume and hence capital cost, plus hypochlorite and caustic usage.

Results from customer trial on waste phenol stream

<table>
<thead>
<tr>
<th>Phenol (ppmw)</th>
<th>Pre-ACCENT</th>
<th>Post-ACCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30,000</td>
<td>0.6</td>
</tr>
<tr>
<td>Chlorinated phenols (ppmw)</td>
<td>0.5-1</td>
<td>nd</td>
</tr>
<tr>
<td>COD (ppmw)</td>
<td>150,000</td>
<td>12,000</td>
</tr>
</tbody>
</table>

Decolorization trials on dyehouse retentate waste (post reverse osmosis unit)

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Absorbance units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-ACCENT</td>
</tr>
<tr>
<td>500</td>
<td>0.000</td>
</tr>
<tr>
<td>550</td>
<td>0.258</td>
</tr>
<tr>
<td>600</td>
<td>1.311</td>
</tr>
<tr>
<td>650</td>
<td>1.202</td>
</tr>
</tbody>
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This test demonstrated the controllable decolorization and COD reduction of the stream allowing recycle of the process water.
**ACCENT in action**

Although the technology was developed for COD removal, it has also been proven successfully in the niche area of decolorization to be a low cost alternative to existing treatments, and is being extended to other problem areas. For COD removal, there is a choice of ways to operate the process:

- to render the stream adequately bio-treatable by converting ‘hard’ COD to BOD (Biological Oxygen Demand);
- to destroy known respiratory or nitrification inhibitors (biotoxins);
- to completely mineralize the pollutants to carbonate, water and sodium salts if no sewer or bio-treatment option exists, involving slightly higher operating costs, but with comparable installed capital and catalyst costs.

The technology flowsheet can encompass many designs including:

- Preliminary treatment upstream of a bio-facility
- Single pass removal
- Tertiary polishing

Integration of ACCENT technology into current plant set-ups is simple. It can be used alongside membrane technology and more conventional bio-treatment, stripping flocculation and sedimentation, and incineration processes.

The optimum operating temperature is about 40-50°C (105-122°F) but there is considerable flexibility to allow operation over a wide range of conditions. As a guideline, Johnson Matthey Catalysts recommends ACCENT technology for removal of up to 45kg (100lbs)/hr of equivalent carbon in the effluent, but this also depends on the degree of treatment required.

**Asahi Glass Co Ltd, Chiba Factory, Japan**

Total flow rate (m³/hr) 3.5
Application Reduction of COD

**AH Marks, UK**

ACCENT customer trials at AH Marks
Johnson Matthey Catalysts: Committed to the Environment

Environmental legislation

Johnson Matthey Catalysts is actively involved in the process of developing legislation to improve health, safety and environmental standards world-wide. We are committed to developing strategies for effective regulation, good housekeeping practices and ongoing research into the safe production, use and disposal of chlorine and its derivatives.

Information is shared with regulators, academics, specialist organizations and the general public and great progress is being made in achieving voluntary phase-out targets.

Johnson Matthey Catalysts fully supports Responsible Care, the global stewardship initiative, and is committed to developing technical solutions to minimize environmental impact and safeguard the health and safety of generations to come.

Environmental standard ISO 14001

Our extensive catalysts manufacturing site at Clitheroe, Lancashire, UK, is registered to the environmental ISO 14001, a further demonstration of our commitment to the environment in every facet of our business.

Catalyst Care Programme

Traditional methods for disposing of discharged catalysts have become increasingly difficult and expensive, and more importantly, environmentally unacceptable. As an alternative for customers, we have introduced our Catalyst Care programme.

How to find out more

If you would like further details about working with Johnson Matthey Catalysts, please contact your local representative or office. We will be pleased to show you how to achieve the optimum solution to waste problems by working in partnership with Johnson Matthey Catalysts.

In addition, we will of course provide you with any further literature about us and technical information about our products.

Get in touch today!
For further information on Johnson Matthey Catalysts, contact your local sales office or visit our website at www.jmprotech.com

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