HCP FIELD APPLICATIONS

FOR HYDROCARBON, CHEMICAL, AND POLYMER PLANTS

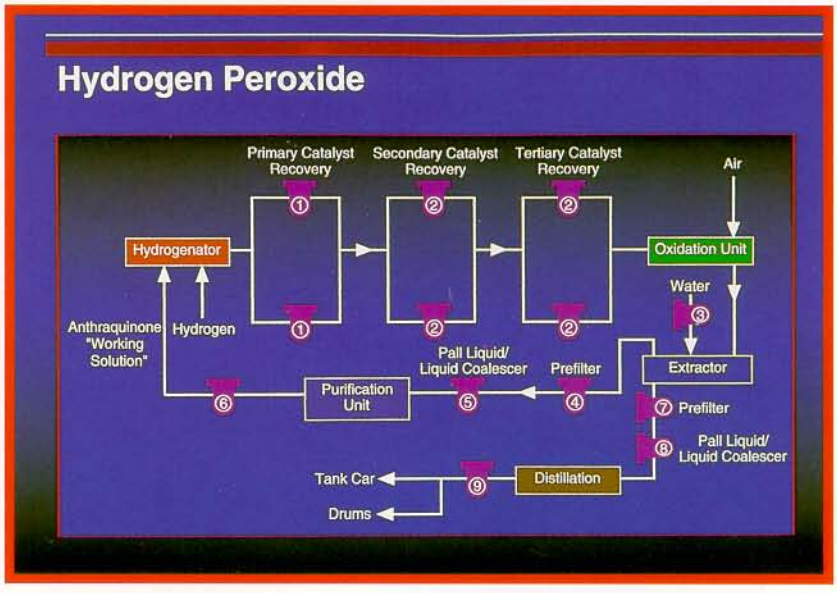
HYDROGEN PEROXIDE

Production Process

Hydrogen peroxide is a mass produced chemical widely used for its oxidizing and bleaching properties in the pulp and paper, textile, chemical, pharmaceutical, cosmetic, and electronics industries. Demand for peroxide has been steadily increasing since it is known to be an environmentally safe chemical alternative to chlorine. Its use is now expanded to exploit its ability to neutralize hazardous pollutants in industrial waste and wastewater streams.

Efficient and reliable filtration is an important part of the production process as it can have a direct impact upon process yield, economy, and safety of operation. The most common method used to produce hydrogen peroxide is the auto-oxidation process, using a working solution. A hydrogenation-oxidation cycle of a suitable working solution (usually an alkylquinone in an organic solvent solution) produces the peroxide which is extracted by contact with deionized water. In the first step of the process, the hydroalkylquinone is formed by reduction of alkylquinone with hydrogen in a reactor. The reaction takes place in the presence of a catalyst (typically platinum, nickel or palladium supported on alumina or silica) at 50–60° C and 1–3 atmospheres. The hydroalkylquinone produced goes through several stages of filtration to remove and recover precious catalyst. It is then fed into an oxidation reactor where air is blown through, producing hydrogen peroxide. The hydrogen peroxide is separated from the organic phase in a water extractor to yield a 35–45% hydrogen peroxide solution. The alkylquinone is purified and recycled back to the hydrogenation reactor.

The peroxide is treated to remove organic impurities processed to achieve the required final product concentration, and is stabilized. It is then loaded into tank cars or drums for distribution.



Pall Filter Recommendations:

1 *Primary Catalyst Recovery (Slurry Reactors)*

The hydroalkylquinone, which leaves the hydrogenator, contains fine catalyst particles. The need to maintain catalyst activity and to maximize the usage of the very expensive noble metal catalyst are strong economic incentives to recover and recycle the catalyst back to the reactor.

Pall recommends regenerable backwash filters for this service. The type of filter medium is carefully chosen to suit the properties of the catalyst: particle size distribution, type, and concentration in each process.

Pall Backwash Systems offer the following benefits:

i) *Process Economy*

Catalyst retention greater than 99.9% substantially reduces replacement catalyst costs. This is a very significant process savings with such an expensive noble metal catalyst being used.

ii) *Reliable Filtration*

Pall filter media are of a fixed pore structure which ensures quantitative removal of catalyst from the working solution downstream of the filters. Use of backwash techniques allow conservation of mass balance in the reactor.

iii) *Low Maintenance*

Pall Backwash Systems can operate in a fully automated mode for continuous onstream service, reducing labor and equipment downtime during process operation.

iv) *Reduction in material handling problems*

By eliminating filter aids (commonly used in traditional separation devices such as plate and frame filters, filter presses, etc.) and recycling the catalyst directly, Pall Backwash Systems reduce the quantity of waste material for disposal or treatment.

2 *Secondary and Tertiary Catalyst Recovery*

It is important to completely remove any residual catalyst from the hydroalkylquinone solution, prior to the oxidation reactor. The presence of catalyst in the oxidation reactor can cause uncontrolled, unwanted chemical reactions to occur. High efficiency filtration is required to remove the catalyst and to ensure the safety of downstream process operation.

Ultipor GF Plus® 1 µm (ß = 5000) filters with polyester hardware or HDC® filters rated at 1.5–4.5 µm (ß = 5000) are recommended. The type and grade of the filter can vary depending upon the Process Licensor and the catalyst used. Consult Pall Process Filtration Company Sales Department for recommendations. Regardless of the type of filter selected, Pall filters ensure effective and efficient removal of catalyst from the hydrogenated fluid.

3 *Water Filtration*

Water is added to the extractor to separate the hydrogen peroxide from the organic phase. The water to the inlet of the extractor is filtered to remove contaminants, such as iron oxides, and to improve product quality, Ultipor GF Plus® 2 µm (ß = 5000) or Profile® II 5 µm (ß = 5000) filters are recommended for this service. The fixed pore construction of Pall's filter cartridges ensures that the fluid is free from particulate contamination. The cleanliness of the final product is maximized by use of clean extractor water from which the product is made.

4,5 *Aqueous Phase Removal From Working Solution*

The working solution exiting from the top of the extractor contains residual water (both free and dissolved). Free water present in the working solution can deactivate the catalyst in the hydrogenator causing low yields. In addition, the water/peroxide phase can be a safety concern due to the ability of the peroxide to decompose and permit the build-up of oxygen.

Ultipor GF Plus® 1µm (ß = 5000) prefilters and the patent-pending Pall PhaseSep™ two-stage liquid/liquid coalescer are recommended for quantitative removal of free water down to 15 ppmv. Pall's specially formulated fluoropolymer medium contains no glass fiber and does not disarm in the presence of surfactants. This results in longer service life and provides higher efficiency of separation than conventional glass fiber or knitted wire coalescers. Separation of the aqueous phase is achieved by passing the fluid through a hydrophobically treated medium. This separator section prevents the water/peroxide from reentering the organic phase. The two fluids are removed by separate drain connections within the housing.

6 *Regeneration Filter*

A 10% stream of the working solution is purified over an adsorbent and recycled back to the stream. Prior to reentering the stream, it is filtered to remove adsorbent, which can contaminate the stream. Pall Ultipor GF Plus 1 µm (ß = 5000) rated filters are recommended for this service. As before, these filters ensure that the fluid is free of particulate contamination. In addition, they provide reproducible fluid quality and long service life. Hence, spent filter cartridge disposal and operator exposure to toxic fluid are minimized.

7,8 *Organics Removal From Crude Peroxide*

Crude aqueous hydrogen peroxide (20–45%) solution is separated from the organic phase and exits the bottom of the extractor. The peroxide is then purified to remove entrained organic working solution and distilled to achieve the desired concentration prior to loading and distribution.

Pall's PhaseSep, horizontal orientation, single-stage liquid/liquid coalescer is recommended to remove the organic contamination from the peroxide. Organics present in the peroxide can reduce chemical purity, lowering product quality. In some cases, where the organic content is high, there is excessive build-up in downstream crude storage tanks. The cleaning and rework of these tanks, along with the associated labor, disposal costs and lost production revenue can have a significant economic impact on the manufacturer.

Testing at various hydrogen peroxide plants has clearly demonstrated that Pall PhaseSep high efficiency coalescers quantitatively remove free organics (up to 26 ppmw) from peroxide solutions and can, therefore, provide significant annual cost savings.

Prefilter selection (type and grade) will vary depending upon filters used in the secondary and tertiary positions. Pall Ultipor GF Plus or HDC II pleated disposable filters (removal ratings from 2–20 µm) are recommended.

9 *Final Product Filtration*

Hydrogen peroxide is shipped in several grades and concentrations ranging from 5–70%. The final product is filtered to ensure product quality, prior to loading into tank cars or drums for shipment. End use of the product determines the filtration level required. For example, the highest purity uses, such as semiconductor production and special military applications, require 0.2 µm final filtration. Pall Fluorodyne® filters are recommended for these applications, For less stringent end-use requirements (removal ratings from 2–20 µm), either Pall Ultipor GF Plus or HDC® II pleated disposable cartridges are recommended.

Literature References

"Profile® II Filter Guide," *Literature code: PRO-400c*
"HDC® II Filter Guide," *Literature code: HDC700b*
"Profile® II Element Data Sheet," *Literature code: E1b*
"Ultipor GF Plus® Element Data Sheet," *Literature code: E7b*
"HDC® II Element Data Sheet," *Literature code: E5b*
"UNI LOC™ Data Sheet," *Literature code: E4*

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