



Application Note AN-PAN-1007

## HP-PO 工中化物的在分析

丙 (PO) 是一从原油中提取的无色但易燃的液体。丙有多工用途,但大部分用于生多元醇,而多元醇是聚多元醇(如泡沫、料、粘合)和丙二醇(如 PET 瓶、、家具)的基本成分。

目前有多生工可用于制造 PO。其中一些工会生副品(如海德林 "CH-PO"、乙 "SM-PO "和甲基 叔丁基

"MTBE-PO"),而一些工不生衍生物(如化 "HP-PO "和炭 "CU-PO")。在些工中,HP-PO 被境的影非常小。

由于生境的危性,本工用明重点介使用防爆工分析在化 ( $H_2O_2$ ) 的 HP-PO 工。在分析有助于提高丙的量,同以低的原料消耗降低成本,并保在一高度危工中工作的操作人有一个安全的工作境。

Propylene oxide (PO) is an important intermediate product for several markets because of its wide range of applications that are predominantly used in the polyurethane and solvent industries.

The global production of PO is more than 10 million tons per year [1]. This market is still growing and with it the need for a more cost

efficient and environmentally friendly production process. PO production methods are available both with and without byproduct materials (**Table 1**). Depending on the market for these byproducts, one or more of these processes may be in major use globally at any time.

**Table 1.** List of propylene oxide production processes categorized by whether they produce co-products or not.

Processes with co-products	Derivative-free processes
Chlorohydrin «CH-PO»	Cumene «CU-PO»
Styrene «SM-PO»	Hydrogen Peroxide «HP-PO»
Methyl <sup>tert</sup> -butyl ether «MTBE-PO»	

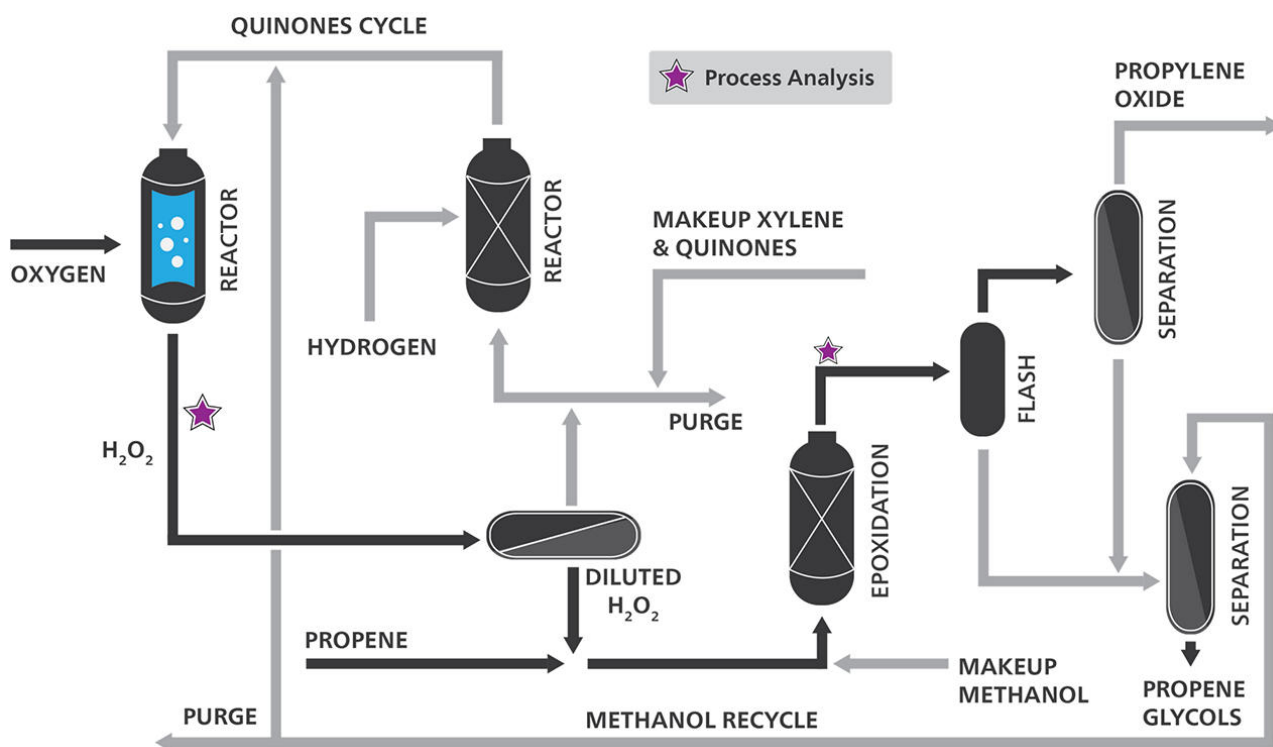
The hydrogen peroxide to propylene oxide («HP-PO») process creates PO from propene (C<sub>3</sub>H<sub>6</sub>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) using a titanium silicate catalyst (**Reaction 1**). This process is preferred over others since it has the smallest environmental footprint compared to all other existing technologies. Additionally, it has been proven to guarantee high yields of PO with only water as a byproduct.

H<sub>2</sub>O<sub>2</sub> present in a methanol solvent is used as the *sole oxidizing agent* and is the critical feedstock and key parameter to measure the complete conversion rate to PO. Thus, there is a high demand for accurate and robust online process monitoring throughout the whole HP-PO reaction process.



**Reaction 1.** Overall reaction for the epoxidation of propylene with hydrogen peroxide (HP-PO).

Considering the dangerous nature of this process, online measurement techniques are key for safety reasons. H<sub>2</sub>O<sub>2</sub> can be accurately monitored in the effluent of the **primary reactor** using an online analysis solution designed for extremely hazardous areas (**Figure 1**).



**Figure 1.** Schematic process diagram outlining the hydrogen peroxide-propylene oxide (HP-PO) method for byproduct-free PO production. Stars note where online process analysis can be integrated for safer, more efficient operations.

Additionally, analyzing the residual  $H_2O_2$  concentrations in **finishing reactor** overheads upstream of the propene recovery section ensures that unreacted hydrogen peroxide is closely monitored for control measures after the epoxidation reactor (**Figure 1**).

Due to the hazardous environment at these production plants, strict safety precautions have

to be implemented with all production and process equipment. The **ADI 2045TI Ex proof (ATEX) Process Analyzer** from Metrohm Process Analytics (**Figure 2**) complies to all electrical safety requirements and is specifically designed for high throughput processing in hazardous locations.

## APPLICATION

Hydrogen peroxide is analyzed by using a complexing agent followed by a colorimetric measurement with dipping probe.



**Figure 2.** The Metrohm Process Analytics ADI 2045TI Ex proof (ATEX) Process Analyzer.

**Table 2.** Key parameters to monitor in HP-PO effluent streams.

Analyte	Effluent of the primary reactor (%)	Effluent of the finishing reactor (%)
H <sub>2</sub> O <sub>2</sub>	0–2	0–0.25

[White Paper: Utilizing online chemical analysis to optimize propylene oxide production](#)  
[Determination of sulfuric acid in acetone and phenol](#)  
[Monitoring of 4-tert-butylcatechol in styrene in](#)

[accordance with ASTM D4590](#)  
[Inline process monitoring of moisture content in propylene oxide](#)

## BENEFITS FOR ONLINE ANALYSIS IN PROCESS

- Protection of company assets with built-in alarms at specified warning limits
- Accurate moisture analysis in hygroscopic sample matrix
- Safer working environment for employees (high temperature and pressures, autopolymerization, ATEX)
- Increased product yield with an optimized production process: more profitability



## REFERENCES

1. Kawabata, T.; Yamamoto, J.; Koike, H.; Yoshida, S. *Trends and Views in the Development of Technologies for Propylene Oxide Production*; Sumitomo Kagaku, 2019; pp 4–11.

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## CONFIGURATION



### ADI 2045TI Ex proof Analyzer

ADI 2045TI Ex proof Process Analyzer 防爆分析用在防爆保作重要安全要求的危境中。分析符合欧盟指令 94/9/EC(ATEX95),并已得 1 和 2 区域的可。分析的合了吹/力系,具有本安型子。空气吹和持超可防止境空气中任何具有潜在爆炸危的物竟如分析外。分析的巧妙避免了吹洗分析体的繁工作,且可安放于危区内的生上。

滴定、休滴定、光度法、使用子性量,以及直接量等所有操作均可用此防爆款型完成。