MITSUBISHI CHEMICAL GROUP | Mitsubishi Chemical Corporation

Mitsubishi Chemical Oxo Alcohol Technology

1. PROCESS FEATURE

The characteristic and superiority of Mitsubishi Oxo Process are following points.

(1) **Very high quality of products**

The major derivatives of OXO alcohols are plasticizers and acrylates. From the quality point of view, not only the normal specifications but also small amounts of impurities are highlighted by our investigations. The small amounts of impurities are hardly able to be removed by easy distillation of alcohol. Typical advantage of Mitsubishi OXO Process is it provides super grade alcohol, containing negligible level of those impurities. Mitsubishi OXO Process is able to produce the highest grade alcohol in the world. This feature would be a great advantage for the user of Mitsubishi OXO Process.

(2) **High conversion efficiency**

Two steps reaction makes high propylene conversion.

(3) **Economical process**

Investment cost and energy consumption are low, because of lower reaction pressure and moderate reaction temperature,

Plant utilizing Mitsubishi OXO Process needs less labor cost, because of simple process and stable operation. Particularly less management man-power is needed because the catalyst activity is stable and so management is not necessary.

(4) **Easy operation**

Simple process and adequate control system provides easy operation. Mitsubishi OXO Process has specially advanced OXO Reactor control system to stabilize the reaction rate and productivity. The selectivity, which is related to the product ratio of normal- and iso-Butyraldehyde, is also adjusted easily.

(5) **Catalyst recovery process**

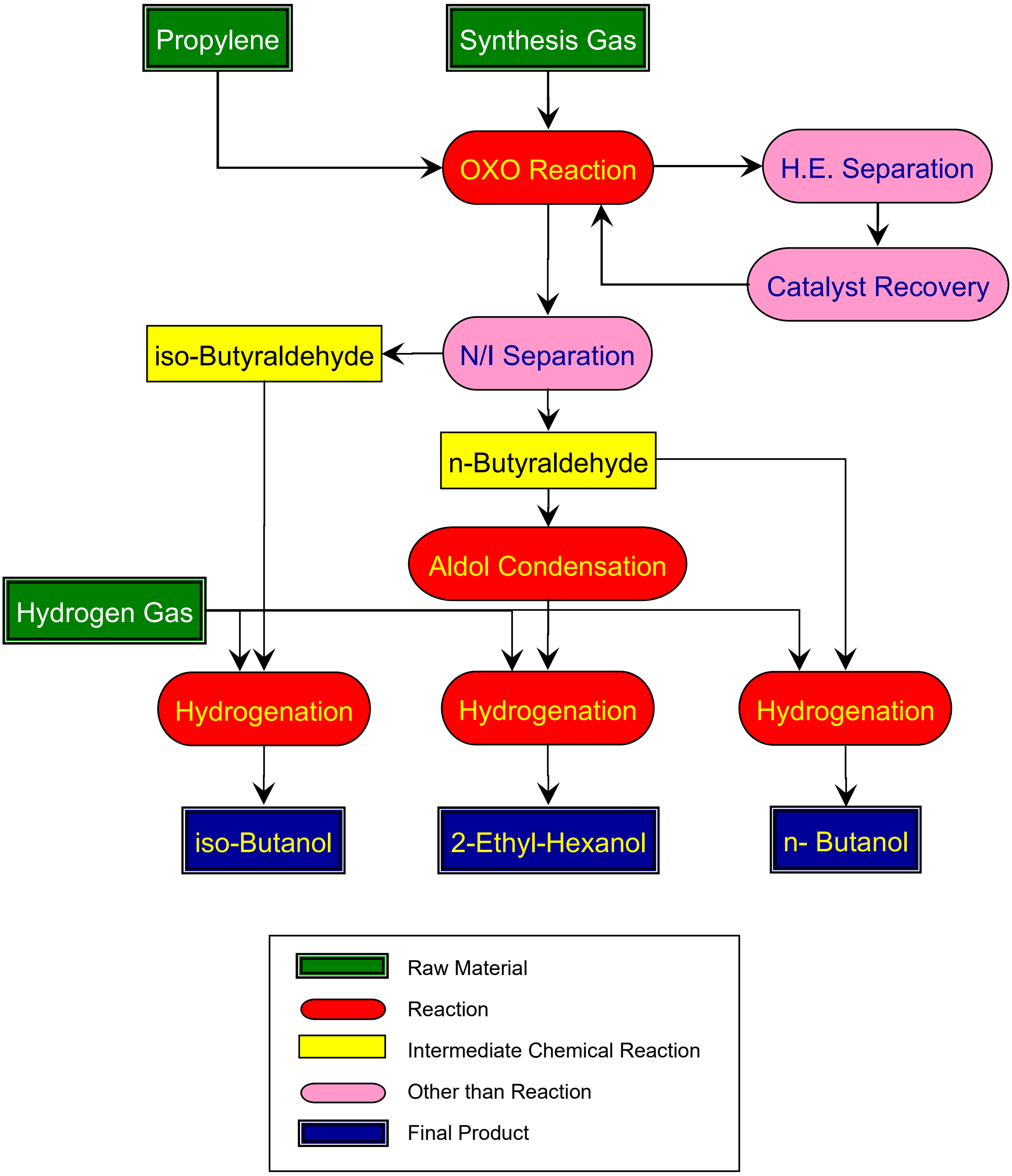
Catalyst activity is stable and high, because of continuous operation of Heavy End Separation process and Catalyst Recovery process. Stable and high catalyst activity result in stable plant operation and less labor cost.

MCC has a special process that can recover the greater portion of the expensive Rh metal within the battery limit.

(6) **High safety**

The advantages mentioned above are also the basis of higher safety of Mitsubishi OXO Process.

2. BLOCK FLOW DIAGRAM



3. PROCESS DECCRIPTION

PLANT consists of the following four sections.

(1) OXO Section
(2) 2EH Section
(3) NBA Section
(4) IBA Section

3.1 OXO Section

In this section, NBD and IBD are produced from Propylene and Syn-gas.

This section consists of the following four process.

(1) OXO Reaction Process
(2) Aldehyde Separation Process
(3) Heavy End Separation Process
(4) Catalyst Recovery Process

The major reactions are as follows.

$$\underbrace{CH_3CHCH_2}_{\text{Propylene}} + \underbrace{CO + H_2}_{\text{Syn-gas}} \longrightarrow \underbrace{CH_3CH_2CH_2CHO}_{\text{Normal- Butyraldehyde (NBD)}}$$

$$\underbrace{CH_3CHCH_2}_{\text{Propylene}} + \underbrace{CO + H_2}_{\text{Syn-gas}} \longrightarrow \underbrace{CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}HCHO}_{\text{Iso-Butyraldehyde (IBD)}}$$

3.2 2EH Section

In this section, 2-Ethylhexanol (2EH) is produced from NBD and hydrogen gas.

This section consists of the following three process.

(1) Aldol Condensation and EPA Distillation Process
(2) EPA Hydrogenation Process.
(3) 2EH Distillation Process

The major reactions of Aldol Condensation are as follows.

$$2\ NBD \longrightarrow CH_3CH_2CH_2CH(OH)CH(CH_2CH_3)CHO$$

Butyraldol

$$CH_3CH_2CH_2CH(OH)CH(CH_2CH_3)CHO \longrightarrow CH_3CH_2CH_2CH{=}C(CH_2CH_3)CHO + H_2O$$

Butyraldol | Ethyl Propyl Acrolein (EPA)

The major reactions of hydrogenation of EPA to 2EH are as follows

$$EPA + H_2 \longrightarrow CH_3CH_2CH_2CH_2CH(CH_2CH_3)CHO$$

2-Ethylhexanal

$$CH_3CH_2CH_2CH_2CH(CH_2CH_3)CHO + H_2 \longrightarrow CH_3CH_2CH_2CH_2CH(CH_2CH_3)CH_2OH$$

2-Ethylhexanal | 2-Ethylhexanol (2EH)

3.3 NBA Section

In this section, Normal-Butanol (NBA) is produced from NBD and hydrogen gas.

This section consists of the following two process.

(1) NBD Hydrogenation

(2) NBA Distillation

The major reaction of hydrogenation of NBD to NBA is as follow.

$$CH_3CH_2CH_2CHO + H_2 \longrightarrow CH_3CH_2CH_2CH_2OH$$

NBD | Normal-butanol (NBA)

3.4 IBA Section

In this section, Iso-Butanol (IBA) is produced from IBD and hydrogen gas.

This section consists of the following two process.

(1) IBD Hydrogenation

(2) IBA Distillation

The major reaction of IBD Hydrogenation of IBD to IBA is as follow.

$$CH_3\underset{\displaystyle CHO}{\underset{|}{C}}H_2CH_3 + H_2 \longrightarrow CH_3\underset{\displaystyle CH_2OH}{\underset{|}{C}}H_2CH_3$$

IBD → Iso-butanol (IBA)

4. Mitsubishi Chemical Phosphite Process

4.1 General

Mitsubishi Chemical Corporation (MCC) has developed a new rhodium-bisphosphite (A4N3) catalyst for the hydroformylation of propylene (PPY), which shows three times higher catalytic activity than that of the current catalyst based on the rhodium-triphenylphosphine (TPP) and also has extremely high linear-selectivity and high thermal stability.

4.2 Features of the New Oxo Catalyst

(1) High N/I Ratio

The new bisphosphite ligand, A4N3, increases the N/I ratio remarkably. MCC's Oxo catalyst shows the highest linear-selectivity of all of the PPY-hydroformylation processes.

(2) High Thermal Stability

As the A4N3 also has high thermal stability by the introduction of methyl groups in the bridging biphenol unit, the catalyst can be used at high temperature.

4.3 Application to Other Olefins

(1) Hydroformylation of 2-Butene

2-butene can be hydroformylated to linear valeric aldehyde by using the rhodium-A4N3 catalyst. The catalyst can be applied to the hydroformylation of Rffinate-2.

(2) Hydroformylation of 1-Octene

MCC's bisphosphite catalysts show the best linear selectivity among all of the well-known linear-selective catalysts.

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