CO-PRECIPITATION TECHNOLOGY FOR PREPARATION OF SOLID CATALYST IN OLEOCHEMICAL PROCESSES

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611

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Catalysis promotes chemical reaction to speed up the performance rate without it being consumed or produced during a process. In chemical and petroleum refining industries, more than 90% of the processes rest on catalytic mechanisms. In the petrochemical industry, catalysts play a very important role in the production of oleochemicals and derivatives. Catalysts often improve the economic competitiveness of oleochemicals and enhance their widespread use. Conventionally, homogeneous catalyst either acidic or basic are used in oleochemical processes. On the other hand, heterogeneous catalysts (solid catalyst) in oleochemical reactions are becoming important because:

- it poses a define catalytic site, thus increased catalytic activity and process efficiency;
- it can reduce cost as it is easily separated from a reaction mixture (*Figure 1*); and
- it can be reactivated and reused after the first reaction.

TECHNOLOGY FOR CATALYST DEVELOPMENT

Catalyst can be prepared by a variety of ways to suit a chemical process. Usually, the methods used for catalyst preparation are impregnation, precipitation, sol gel, physical mixing, wash-coating and pelleting. However, co-precipitation technology is the most common method used in preparing mixed oxide-based solid catalyst. It is a controlled chemical equilibrium shifting process involving incorporation of trace elements into a mineral structure during solid formation and recrystallisation of minerals. This process will reduce the mobility and toxicity of the trace elements in the mineral. Co-precipitation can be conducted with many specific steps involving preparation of the specific solutions of metals compound, mixing the solutions, drying and calcinations. Further validation of solid catalyst properties and characteristic are via characterisation analysis (*Figure 2*).

COMPARISON OF HOMOGENEOUS AND HETEROGENEOUS CATALYSTS

Majority of the industrial catalysts are solids. In contrast, the proportion of non-solid catalysts (liquid and gases) are very small, based on many criteria and properties, such as mass, value and size of industrial plants (*Table 1*). Solid catalysts often contain two or several solid components in various composition providing specific porosity and surface area that must be carefully controlled to obtain high activity, good selectivity and stability in time during the catalytic reaction (*Table 2*).

ADVANTAGES OF CO-PRECIPITATION TECHNOLOGY

The co-precipitation technology is preferred over other catalyst development technologies because:

- it involves simple steps and time saving process;
- the particle size and composition are easy to control;
- there are various possibilities to modify the particle surface state and overall homogeneity; and
- it gives high output and recovery.

All these factors lead to low production cost.

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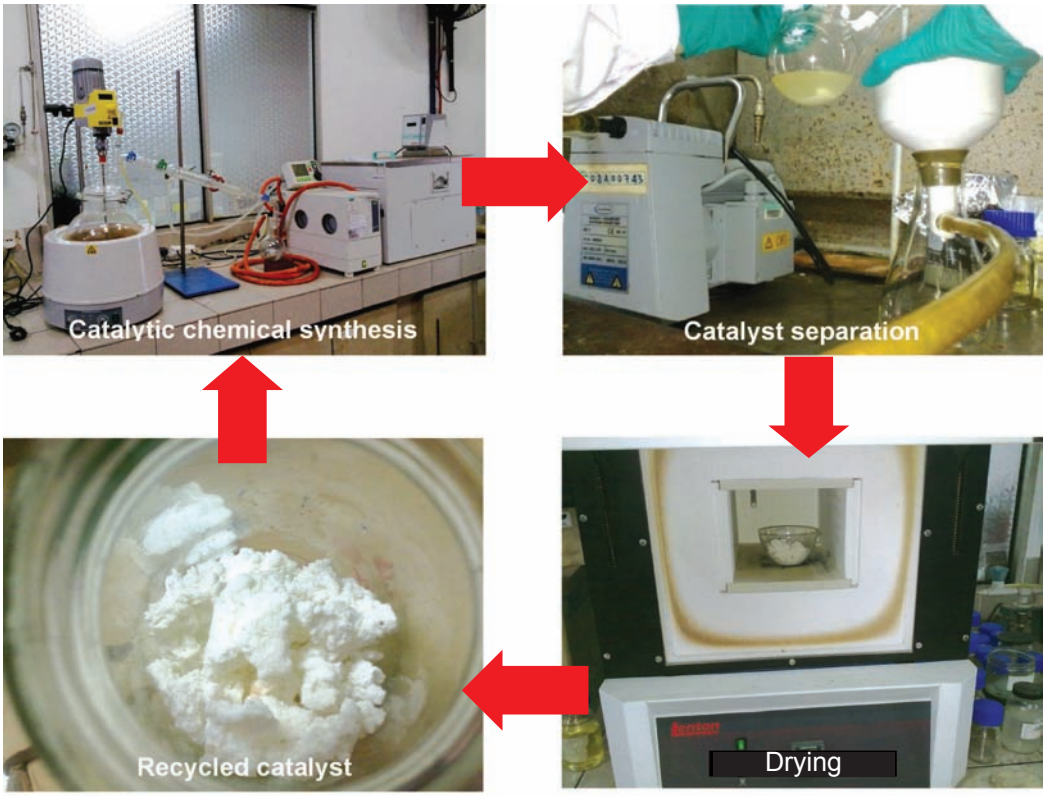

Figure 1. Regeneration process flow of heterogeneous catalyst.

Figure 2. Instrumentations for characterisation of catalysts.

TABLE 1. PROPERTIES OF HOMOGENEOUS *vs*. HETEROGENEOUS CATALYSTS

Property	Homogeneous catalyst	Heterogeneous catalyst
Catalyst recovery	Difficult and sometime impossible	Easy
Thermal stability	Poor	Good
Selectivity	Excellent single active site	Good - multiple active sites
Cost of production	Expensive	Potentially cheap

TABLE 2. CHARACTERISATION OF DRIED AND CALCINED HT130 CATALYST USING BRUNAUER-EMMETT-TELLER (BET) TECHNIQUE AT THREE DIFFERENT TEMPERATURES.

HT130 Catalyst	Surface area (m^2 g^{-1})	Total pore volume (ml g^{-1})
HT130 dried	76	0.28
HT130 calcined at 400°C	177	0.60
HT130 calcined at 450°C	193	0.66
HT130 calcined at 500°C	225	0.73

POTENTIAL APPLICATIONS OF HETEROGENEOUS CATALYST

There are a wide range of solid catalysts applications. The potential applications include:

- catalyst for the production of oleochemicals and its downstream value-added products;
- flame retardant;
- additives for polymers; and
- water purifying agent.

ECONOMIC ANALYSIS

Payback period = four years.
Return on investment (ROI) = 25%.

CONCLUSION

Co-precipitation technology is a simple and economical method to produce heterogeneous catalyst. The mixed oxides resulting from calcination can be useful in catalytic applications, because of the high surface area, large pores and good distribution of metals on the surface. All these provide flexible active sites with good selectivity.

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