

Modularization in Chemical Industry

The modularization concept in chemical industry is comparatively a newer trend. It is about configuring a plant through the assembly of multiple modules to make a complete plant. It is an alternative to traditional stick-built construction. This article provides a valuable insight on this new trend. Not only that, it also emphasizes the best practices being followed by one of the leading chemical engineering company – Praj Industries Limited.

Changing paradigm in Chemical Industry:

The paradigm of project execution has been rapidly changing due to the change in market and economic scenario in the Chemical Industry. Today, the expectation is to complete the project in shortest possible time to improve the payback period as well as the return on investment (ROI). In addition to that, the safety norms and labour regulations at site are getting tougher and tougher.

In view of achieving the above, the industry has been trying to innovate the way the projects are being conceptualized and implemented.

Modularization:

One of the new trends in project conceptualization in chemical industry is: "Modularization".

Modularization is not a new concept in Oil & Gas Industry, particularly in offshore applications as well as remote Oil & Gas processing plants in upstream and midstream sector.

However, in chemical industry, the concept of modularization is comparatively new because most of the chemical plants are in the industrial areas where labour availability,



Large modules for Oil&Gas applications

Chemical Modular Plant





Fully Modularised including columns

Plant size – (LxWxH)
17.0m x 14.0m x 12.5m

Max. Height – 30.0M (Top of Column)

No. of Modules – 10

Modules Size –
5.0m W x 5.0m H

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transportation, etc have been favourable compared to remote locations.

What is "Modularisation"

Simply putting modular plant can be defined as 'Process System contained within a frame' that allows the complete system to be transported.

Thus, a Module is an alternative to traditional stick-built construction where process

system is shipped from the fabrication yard and installed at the site.

Interestingly, there is always a confusion about what exactly it means in Process Plants because module is a very generic term. Often, a module is imagined as a very large system which generally transported on a barge or ship. And as such, the modularisation concept is often considered



Type	Units	General Size	In the Shop / Yard	Transportation	At Site
Type 1	Single Process Unit	Containerized / Truckable	Complete assembly and Pre-Comm	As a Single Unit	Plug and Play
Type 2	Process Package Assembly of multiple units	Scalable and Flexible. Transportable by road (Containerized/ Truckable)	Complete Assembly, Pre-comm, and Dismantling of individual units	In multiple units and spools of inter-connecting piping	Assembly of units + Spools (Like Lego)
Type 3	Process Package Single large Unit	Very Large Difficult to transport by road	Complete assembly and Pre-Comm	As a Single Unit – Generally by barge/ ship	Very large cranes

not practical because chemical plants are located where such huge equipment cannot be transported.

Modularisation : Praj Perspective

At Praj, we have a very different perspective of modularisation and we define Modularisation as :

Configuring a plant in a way where multiple Modules are assembled to make a complete plant.

Thus, A Modular Plant is :

- "Process System within a structure "
- Complete in all respect till structure limits / battery limits
- can be small or large depending on the transportation feasibility
- Can be single or multiple levels
- Transportable and easy to assemble at site

To simplify the understanding of the modular plant, we have internally defined modular plants in 3 different ways –

These definitions are very helpful while imagining and explaining the configuration of a plant.

Praj way of modularisation :

Being the Technology and EPC company along with our own manufacturing facilities, we at Praj are able to conceptualise and design the modular plant in a more construction friendly and cost-effective way.

Praj specializes in converting Stick-Built process packages into Type-2 Modular Configuration for Chemical and PetroChemical Plants

Praj is uniquely positioned to leverage in-house competencies:

- Process understanding – Being a Technology / Chemical Engg company
- Multi-disciplinary Engineering
- Manufacturing / Assembly shops
- Experience of logistics all over the world
- Experience of installation of plants : Both – Stick-built and Modular

Over the years, Praj has been modularized many packages in various configuration :

1. Fully modularized – Container size – All sub-modules are container size and can be transported in standard containers
2. Fully modularized – Truckable size – Sub-modules are of truckable size (approx. width 4.5 to 5 m)
3. Mixed Modularized – Containerized + Truckable – Some of the sub-modules are truckable size (4.5 to 5 m width) and some are container size
4. Partially modularized – Large Equipment Off-Module – Sub-modules are container or truckable size but large equipment like Columns or Reactors are kept stand-alone.

Size does not matter – SIZING matters :

Irrespective of the size of the plant, the modularization is possible provided the sizing of individual sub-modules are done thoughtfully. While conceptualizing the sizing, following aspects are considered:



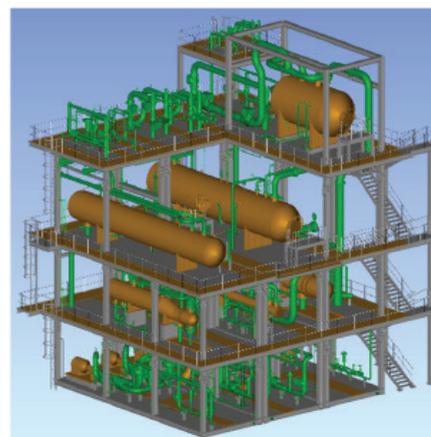
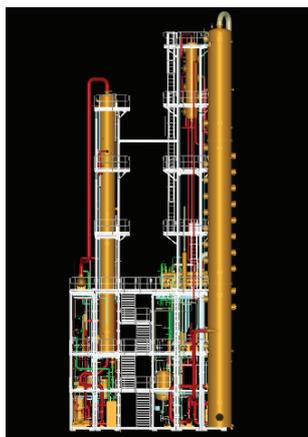
Type 1
Single Process Unit



Type 2
Multiple Process Units Assembled Together



Type 3
Multiple Processes in Single Large Unit



- Location of site
- Safety norms
- Transportation Limits – From Shop / To site
- Availability of Cranes

Process of Modularization – A joint development

While developing the modularization concept, the most important thing is joint efforts between the client and modularization company.

At Praj, we always work together with client’s team in following steps :

1. Understanding workshop - Detail understanding of Process Scheme, PFD, P&ID, and other details
2. Concept sketches – Configuration
3. Equipment placement
4. Process Validation workshop – Client process team participates to

5. Preliminary Model with major lines
6. Optimization workshop – review sizing of modules / Possibility of resizing of equipment
7. Finalization of configuration
8. Complete Modeling of Modular Plant

Steps 1, 4, and 6 are carried-out in a development workshop method where clients participate to validate the design. This creates a synergy in thought process and approach to the project execution.

Challenges in Modularization :

While modularization is a very effective way of configuring a plant, there are certain challenges which must be kept in mind and shall be mitigated.

1. Concurrent Engineering at Client and Module supplier is a MUST.

2. Difficult to accommodate Process Design change after finalization of configuration
3. Model review steps must be very stringent
4. Weight and cost of structure may be higher (But many a time saves site civil construction cost)
5. Requirement of suitable space for assembly at shop / yard
6. Meticulous planning required for B/O items as there is less flexibility to accommodate at a later stage.

All these challenges can be overcome by proper planning and teamwork between modularization company and client.

Benefits of Modularisation :

The most important benefit is - Modularisation becomes a “No Surprise” project at site as complete assembly is carried-out in the fabrication shop before the FAT / Pre-commissioning phase.

Over the years of experience in modularization, Praj has developed a competency in conceptualizing and manufacturing the modular plants for chemical industry and can claim that.

"Modularisation: a Safer, Faster, and Cost-efficient Way of Executing the Project". ■

Areas	Benefits	Savings potential
Plant Design / Engineering	<ul style="list-style-type: none"> • Transportable Design • Smaller Footprint 	20-30 percent Footprint savings possible
Procurement/ Inbound Logistics	<ul style="list-style-type: none"> • Reduction of procurement items and subsequent logistics for EPC / End-client 	Savings in co-ordination efforts and consequently man-hours
Manufacturing/ Assembly	<ul style="list-style-type: none"> • Safer conditions than site • Controlled assembly and QA • FAT before installation 	Site labour cost saving from 25 to 75 percent possible depending on site
Overall Schedule	<ul style="list-style-type: none"> • Faster Installation at Site • Minimizing and controlling risk during construction • Accelerated schedule • Faster start of production 	25 to 30 percent compressed schedule possible

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