

## Consulting Services from ClearWaterBay Technology (CWB Tech)

### OUR EXPERTISE

We specialize in **process synthesis & development projects** for the petrochemical, pharmaceutical & API, fine & specialty chemicals, polymer, and refining industries. Process development is a multi-disciplinary exercise for creating the best process for manufacturing the desirable product(s) with given specifications, such as purity or morphology, within the given budget and resources and in the shortest development time. CWB Tech has solid experience in solving problems in all areas of chemical processing. Our expertise is in **crystallization & solids processing, reaction engineering & reactor design, separations, polymer processing, and energy analysis**. Whether your needs are spread over the entire process development spectrum, or limited to only one or two components, CWB Tech can address your specific problems with the right tools and the right amount of detail required.

### TYPE OF PROJECTS WE HANDLE

CWB Tech handles projects from Preliminary Study and Analysis to detailed Synthesis, Design and Development in all areas of our expertise. The project objectives may be **Troubleshooting** or **Debottlenecking** of the process or a particular unit operation, **Process evaluation** for performance improvement (e.g. increasing capacity and selectivity, more energy efficient designs etc.), to generation of completely **New Process Design** schemes. CWB Tech has expertise in the conceptual design as well as the detailed modeling and analysis required in solving such problems. One of our unique service offerings is **Conceptual Design**, which involves a systems level analysis of the particular process using heuristics as well as quantitative analysis tools.

#### *Conceptual Design*

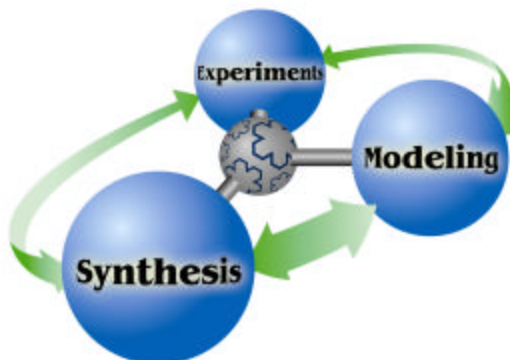
Many methodologies exist for conceptual design as applied to the task of identifying the optimal process configuration or processing unit. This exercise may be carried out to explore improvements in an existing process, or, come up with a totally new design. We at CWB Tech have extensive training and experience in many aspects of this area. Being results-oriented, we select the methodology based upon three factors: *Available information*, *Time scale of the project*, and *Objective of the project*. The Conceptual design exercise typically proceeds with the following steps:

- A decision of whether it would be profitable to manufacture a particular chemical subject to your particular considerations
- The chemical and physical basis for the process is discovered and a corresponding flowsheet and operating policy are generated
- Process alternatives are generated and evaluated to identify optimal choices for a particular process
- Improvements which can be adapted to an existing process through retrofitting are identified

An important step in conceptual design is **Conceptualization and Dominant Factor Identification**. This involves creating a conceptual picture of the underlying phenomena in order to bring understanding to the problem. The degree of detail in the conceptualization is chosen such that the resulting model provides insights into the chemical process. Once the dominant factors are understood, recommendations can be made for achieving product specifications, increasing productivity, or for any other related objective.

### **The CWB APPROACH: MOPD — Multi-scale Objective-Oriented Process Development**

At CWB Technology, we have pioneered an approach called Multi-scale Objective-oriented Process Development (MOPD). This involves focusing on the appropriate scale (i.e., enterprise, plant, equipment, transport, particle, molecular), to tackle the project with the right level of detail. By clearly stating the objectives of each task in the project, we focus on achieving these objectives and minimize the time and effort required to complete the tasks. MOPD has three interconnected components: synthesis, modeling, and experiments.



**Figure 1: Connections between synthesis, experiments, and modeling**

### *Synthesis*

- Conceptual short-cut analysis to quickly identify the constraints in an existing process
- Technological and economic feasibility study of the process
- Generate process alternatives by applying systematic synthesis methods

### *Modeling*

- Develop appropriate models, based on the objective and scale of the problem
- Perform detailed analysis of process alternatives by rigorous modeling and simulation
- Perform sensitivity analysis to identify the variables dominating process performance
- Optimize operating conditions and operating policy to achieve highest productivity and safety

### *Experiments*

- Interact with your chemists and researchers to identify the most valuable data, and advise on the manner of data generation
- Collaborate with other parties, such as the Consortium of Chemical Products and Processes (CCPP) at HKUST, to create the most advanced and most effective experimental methods and procedures in generation of valuable data

## **WORKFLOW IN CONSULTING PROJECTS**

With our MOPD approach we can help to optimize the process development workflow. Your workflow is the order and method of execution for the elements of synthesis, modeling, and laboratory or pilot plant experiments. Even though each company may have a completely different workflow, CWB Tech's expertise can help to optimize it with respect to the variable resources in your particular company to achieve the shortest development time, the least development cost, or a combination of the two.

### *Typical project timeline*

1. *Preliminary Study*: The first step is to clearly define the objectives and scope of the project. The preliminary study involves brain storming with your in-house experts who are involved with the process, and a thorough analysis of the existing data, in order to decide the direction in which to proceed. This step typically will take a few days, depending on the complexity of the problem
2. *Preliminary Quantitative Analysis*: The objective here is to analyze in more detail the key issues identified in the preliminary study. This step may involve preliminary modeling activities in order to capture the key effects in the process or the unit operation, and to identify the parameters dominating its performance. We aim to build a model or hypothesis which reproduces the correct trends as observed in the lab or in the plant. This step may take from one to three months, depending on the complexity of the project.



3. *Detailed Analysis:* The objective here is to undertake detailed quantitative analysis of the individual issues or problems identified before. This may involve some additional data collection or experimentation to validate the hypotheses and tune the models. Case studies and sensitivity analysis are carried out to explore various alternative solutions. Unique engineering solutions are proposed to solve the key project objectives. This step may take a few months depending on the extent of the project.

#### **VALUE ADDED**

CWB Tech has the best expertise for solving process development problems. Not only have CWB engineers spent many years doing research on developing the best methodologies for solving such problems, they have also successfully adapted and applied them to industrial problems. The benefits of working with us include

- Unique approach – Results oriented engineering work, focused on delivering the objectives
- Unique technology solutions – Reduced down-time, Reduced investment cost, Increase in productivity, Identification of Process Bottlenecks, Improvement in Product Quality, Generated Clear Understanding of the Process and Establishment of a Stronger IP Position
- Our Experience – Ability to apply various process synthesis technologies for solving industrial problems and R&D experience in the area of reaction engineering, crystallization and solids processing

Our unique results-oriented approach based on extensive experience and engineering fundamentals will lead you to a clear understanding of your process and a higher level of performance. Contact us and let us help you to develop your process within the given budget and resources in the shortest development time.