Engineering Consulting & Training Services

CARMAGEN Engineering, Inc.

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Making or Saving Money in Process Engineering Areas for Petroleum Refineries

By Carmagen Engineers

What is your best cost-effective tip for refineries is a question we posed to our 180+ engineers. The majority of our engineers have 35+ years of experience, so they know what they are talking about. The following are their answers for the process engineering side of the refining industry. There will be another article that will cover this topic for the non-process side of the industry as well.

General Tips

Make sure that changes and upgrades are properly noted and changed in all of the manuals and equipment information and materials lists. It is costly and time-consuming when equipment is taken out of service for repairs and the replacement or repair material is not compatible because it had been ordered from information that had not been updated according to the latest revision.

Planning saves in the long run.

Have well-trained and motivated operators and a system plan to support them.

Work hard to go down the experience curve with at least a one percent improvement every year.

Make sure that all stakeholders are aligned with job scope, cost and schedule before proceeding to the next stage of any activity. Rework due to misalignment, lack of consensus, and poor understanding of technical and business scope can lead to significant rework costs and ultimately project mortality. **Must make sure that all are paddling in the same direction.**

Blending

In the current economically uncertain environment, it is extremely important to determine how much money, if any, you make on every barrel of blended product.

The basic principle is simple: for every blend batch, the profit is:

Profit of Blend Batch =
(Product Batch size X Selling Price) – Sum (Blend Component Volume X Component Price)

- The selling price for a refinery is the price you get from your commercial/logistics/supply and trading department or Planning and Economics department. For a trader, it is approximating prices by interpolating between regular and premium prices from available information sources (e.g., Platt's, OPIS, etc.).
- Blend component prices can come from two different sources: either from a refinery LP monthly run marginal prices, or as a trader, the prices paid for the purchased components.

Work Highlights

Mechanical Engineering

Providing Mechanical Engineering Quality Control support for a US client on their Sulfur Recovery Unit and Hydrotreater Unit capital projects. Also providing similar Machinery Engineering Quality Control support for a European client on their refinery upgrading project. This support involves reviewing the contractor's and equipment suppliers' work to help ensure that they meet the specified project requirements.

Reliability & Maintenance

Performing strategic reliability initiatives for an international refiner, including a hydrocracker catalyst evaluation and reactor loading plan to maintain conversion, increase in run length, control and monitoring system improvements, operator training recommendations, and also produce a 10 ppm sulfur diesel plus assessment of unit performance.

It is amazing how many people do not do this trivial calculation, and do not include it in their monthly Blending Key Performance Indicators reports … people are still debating that the prices are not correct; so what? Instead of squabbling over precision, at least you'll get an indication of roughly where you are in the economics of the operation, and concentrate on fixing meaningful problems to increase profit.

Instead, we still are wasting time and economic improvement opportunity by showing physical blend octane or RVP giveaway as we did 30 or 40 years ago … which are economically small compared with getting the wrong average monthly refinery LP recipes or incorrect short term planned recipes. Remember that the flexibility to "trade horses" is at the refinery LP level, or if you have one, at the multi-blend, multi-time period optimization level, not at the single blend level where we are "stuck" by the constraints inherited from planning. So what we need to think about is avoiding grabbing potential measly 2 to 3 M$ in physical giveaway vs. potentially 10 to 20 M$ or more at the planning level!

Utilities

1. Know where your utilities are going. This is one of the first steps in optimizing operating costs.
2. Tailor and control your products to meet specs while avoiding give-away. Increase your profits by avoiding octane, sulphur, cetane, pour point, etc., give-away while producing your products.

Analyzers

Maximize the use of on-line analyzers. Use the refinery laboratory to validate the analyzers. Use the standards developed by ASTM D 02 Subcommittee 25 on Validation of Process Stream Analyzers.

Capital Projects

Before developing major capital projects, spend some time to make sure that the base case operations have been fully reviewed and optimized, with low cost improvement options identified and implemented. The cost of such a review is minor and may reduce the project capital requirements. For certain, any no- or low-cost improvements uncovered will begin to improve refining margins much quicker than the credits obtained from a major investment program.

Turnarounds

For Refinery Turnarounds: Require all internal manway hardware to be loosened, adjusted and/or replaced before approving re-installation of the internal manways. Lack of such attention to corroded or seized hardware causes additional installation time and incomplete installation, which can lead to tray mechanical failure and/or process losses. This is a common problem that is found at all refineries.

Troubleshooting: When using a "gamma scan" to assess a fractionating column suspected of flooding or other abnormal operation, two gamma scans are significantly more useful than one. The first scan should be taken at hydraulic conditions at rates that result in "normal" operation. The second scan should be taken with rates that first indicate the problem (often higher pressure drop). Heat and material balance data should be taken at each set of operating conditions for process modeling and hydraulic analysis.

Waste

My thoughts are around "continuous improvement" and "elimination of waste."

One definition of Waste is:

The way things *could be*
↑
↑
↑
Waste
↑
↑
↑
The way things *are*

FCCU

I would say the following tip is pretty critical to effective refinery operation:

"It is essential that complex refinery units such as an FCCU have appropriate Emergency Systems that will put the unit in a safe condition in the event of an abnormal situation or emergency. In addition, the unit operators must have sufficient training to recognize the nature of the emergency, evaluate whether the emergency system(s) has/have been properly activated and the correct actions taken, and must be prepared to take suitable follow-up actions, as required."

Safety

If you think that spending money on Process Safety is expensive, then try having a major accident and see what the final cost is. The point being that while modifications to address process safety issues can be expensive, the total costs (i.e., loss of production, increased premiums, legal, damage settlements, personnel liability, etc.), let alone the loss of life, or injury issues, associated with even a moderately severe accident far outweigh these costs. Experience has also shown that companies that have seriously addressed process safety issues experience increased reliability and on-stream time.

LNG Plants

Use either a low energy state-of-the-art impeller technology or gas sparging in LNG Storage Tanks for eliminating temperature gradients and possible tank rollovers that can be serious safety hazards.

Chemistry

"Don't forget to include chemistry (i.e., assay, composition data, or reactivity) in process planning."

Hydroprocessing Units

Nice and Simple ... "Monitor all key processing variables of all hydroprocessing units for optimizing performance."

Steam Traps

The first tip that comes to my mind is reducing refinery steam consumption by replacing malfunctioning steam traps, fixing steam leaks (e.g., tracing on pipes and vessels), and more closely monitoring dispersion steam usage (e.g., burners) and purge steam rates. I think the best solution is an overall audit of a refinery's high, medium, and low pressure steam systems to systematically identify conservation opportunities. This has been practiced by some refiners with good results.

My "best cost-effective tip for refineries" is to conduct an on-site evaluation of all the steam traps in the refinery as to leaks and replacements, and recommend where to install new ones. At the same time, the existing insulation can be inspected and evaluated as to its cost effectiveness.

Profit Improvement

"The hierarchy of profit improvement in refineries is throughput, yield, energy, and staff; the first being the most important.

If there is no incentive to increase throughput, then focus on yield. Try and buy slightly lighter crudes to reduce the vapor load in the vacuum pipestill. This will reduce the flash zone pressure and increase the yield of heavy vacuum gas oil over vacuum resid. Even a small change can be very valuable.

Following yield, continue to focus on energy savings. In many refineries, the marginal fuel is natural gas, and this continues to be expensive."

Pilot Plants

In my experience, the most important aspect of smooth (cost effective) pilot plant operation is the initial program planning with all parties involved [i.e., lead engineer, unit engineers, operators, and support staff (analytical & mechanical)]. Once this groundwork is set, all become involved with ownership (communication) in day-to-day progress of the program.

Tough to manage, but it works...

Root Cause

The most important message is to set up a simple system to identify "bad actors" and allocate engineering resources to resolve the root cause.

Summary

Having managed to avoid working in the oil industry during my active years has left me with little or no experience in that industry. On the other hand, there is one thing that I know and it is this: refineries can save money by using the substantial expertise of those working at Carmagen as consultants. Their training and experience prepared them to zero in on specific problems without having to go through a learning curve.

These tips have been provided by many of Carmagen Engineering's process engineers. We have ready access to over 180 engineers who span the full spectrum of process and equipment technologies as well as project management services. The average experience level of our professional staff is over 30 years. Please contact Jerry Lacatena (jlacatena@carmagen.com) if you'd like more information on Carmagen's process engineering expertise.

Would you like more information about Carmagen? Please visit our website at www.carmagen.com.