Introduction

The economic slowdown caused by the COVID-19 pandemic resulted in many industries experiencing steep decreases in demand for their products and services. The hydrocarbon processing industry (HPI) was no exception. Global oil demand fell by 25% in the spring of 2020 when worldwide response to the COVID-19 pandemic began. The industry has since rebounded and recovered some of its losses, but near-future demand is expected to remain 4% to 7% lower than pre-pandemic levels.\(^1\)

As petroleum and petrochemical companies continue their recovery, they also continue to tackle the challenges their industries were facing before the pandemic, such as:

- Increasing efficiency to lower operating costs and stay competitive within the market.
- Reducing their carbon emissions and adopting bio-based processes and products.
- Investing in their operations to keep up with demand while sustaining a healthy cash flow.

The way in which a company approaches its laboratory analytical program can help them address these challenges.

PerkinElmer partners with Hydrocarbon Processing Industry (HPI) operations around the globe and hosts webinars and global summits to discuss important topics which impact the industry today and in the future. A recent virtual Summit was conducted online to provide the opportunity for industry professionals from around the globe to enjoy keynote addresses, presentations, and roundtable discussions about important topics and analysis challenges that HPI companies are facing.

As a follow up to the Summit, PerkinElmer, Inc. sat down with two leaders from SGS, Teresa Ruiz-Escribano and Arjan Praat, to mine their in-depth knowledge of HPI analytical laboratory trends and challenges. SGS is a global leader in testing, inspection and certification solutions for HPI companies, from global mega-corporations to medium- and small-size enterprises, operating a network of over 200 laboratories in the Oil, Gas and Chemicals industry. Here we discuss several of the top trends and challenges and the ways in which companies are adapting their laboratory programs in response.
Business Trends and Challenges

The petroleum industry continues to find ways to increase efficiency across all aspects of the business. Many older refineries and small refineries are being shuttered because they can no longer be competitive in today’s market.

At the same time, new world-class refineries are being constructed that have state-of-the-art equipment and processes to maximize efficiency. The new complexes are designed to extract all of the available value from feedstocks.

One strategy being used to achieve that goal is to integrate refineries with downstream facilities within one industrial complex. New refineries are rarely stand-alone facilities, but rather are highly integrated with downstream petrochemical facilities. The same strategy is being used at natural gas production sites where adjacent terminals are constructed to capture and trade the NGC, ethane and propane generated from the natural gas.

Incorporating Biochemicals and Recycling

Innovations in bio-based materials continue to expand across industries, and an increasing number of petroleum companies have begun to incorporate bio-based processes into their operations. Biofuel production continues to grow despite the large capital expenditures required to build a new biofuel facility. Petroleum refiners are upgrading and converting their traditional refineries into biofuel production facilities. Doing so is much less expensive than closing, dismantling, and remediating a petroleum refinery. BP, Total, Eni, and others have announced plans to increase their biofuel production this decade. Similar shifts are gaining momentum in the integration of biochemicals production and end-product recycling at refineries and petrochemical facilities.

The analytical laboratory needs for biofuel, biochemical, and recycling operations are unique to each process based on their feedstocks, process intermediates, and end product specifications. They all, however, require a full understanding of the properties, chemical composition, quality, and purity of each material throughout each process. That can be accomplished using some traditional analytical workflows that are translatable to bio-based and recycling operations, while other needs require innovative analytical approaches.

Increasing the Efficiency of Analytical Programs

New refineries and complexes frequently include full-scale laboratories. As with other operations, there is a strong focus on optimizing laboratory operations such as staffing, instrumentation, and number of analyses conducted. Laboratory efficiency is also a focus at existing facilities whether they have an on-site lab, utilize a contracted laboratory, or a combination of the two.

Strategies being used to increase laboratory efficiency include:

- Using analytical instruments within the production process to monitor feedstock and intermediate composition, thereby identifying problems or impurities earlier in the production process.
- Using hyphenated workflows to obtain more data from a single sample run, thus reducing the number of samples collected and analyzed.
- Using instruments that are self-calibrating and programmed to notify the operator when attention is needed. This allows the operator to focus attention on problems such as off-spec process intermediates, catalyst issues, and unknown impurities.

The IEA expects demand for biofuels to increase by 380,000 barrels per day (b/d) to 5.1 million b/d by 2040.

Staffing a Trained Analytical Workforce

Well-trained laboratory staff is essential for every analytical laboratory, no matter the size of the lab or the level of automation used. This has become a challenge for petroleum facilities in North America and Europe where there is now a reduced pool of qualified laboratory technicians and chemists.

One reason for this reduced workforce is that young professionals have been making different choices in their career paths toward what are perceived as more sustainable industries. Thus, petroleum businesses are competing against industries such as life sciences, food, and pharma for good laboratory talent. Petroleum businesses that incorporate biofuels, biochemicals, and recycling into their operations may be able to shift that perception and increase their success in attracting qualified laboratory staff.
Analytical Advances and Trends

Recent Achievements

Over the past decade, providers of analytical instruments and services have been challenged to keep pace with the changing needs of the petroleum and petrochemical industries. Their ingenuity and perseverance have resulted in several key advances for today's laboratory:

- Instruments have become smaller and more agile for use in different physical settings. Many of today's analytical instruments are as at-home on the process floor as they are in the laboratory.
- Instruments have been improved to be more robust in their capabilities and faster, while retaining or even improving their sensitivity.
- Many instruments now also have the ability to conduct computer modeling around the measurement itself.

Advances in specific analytical technologies have also helped improve laboratory operations:

- Chromatography remains a very important analytical technique for the petroleum and petrochemical industries. As customer, regulatory, and environmental criteria have become more stringent, chromatography instruments have been improved to provide the lower detection limits needed to meet new and changing criteria.
- Infrared (IR) spectroscopy use has increased as its capabilities have grown. IR instruments have expanded databases that provide accurate identification of more substances. The computer modeling capabilities of IR spectroscopy instruments are also improved, allowing more versatile applications of the data output.
- Thermal analysis testing instruments and methods, such as thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC) have become more efficient and smarter thanks to advanced data and analytics and predictive modeling.
- Hyphenated workflows have transformed many laboratory programs. Hyphenation refers to the coupling of two or more instruments to increase the power of analysis. Laboratories that adopt hyphenated workflows that are designed for their specific analytical needs enjoy improved efficiency and lower operating costs.

An important driver in all laboratory operations is the safety of conducting laboratory methods and operating the equipment. Sample preparation methods for many analyses have been redesigned to be safer as well as more efficient.

Even with these improvements, providers have found a way to make their instruments more cost-effective, which helps petroleum and petrochemical companies reduce operating costs.

Current Trends and Challenges

The petroleum and petrochemical industries continue to evolve, and they need their analytical program to keep pace with their changing needs. A few of the current trends and challenges that will impact the industries’ laboratory operations include:

- Hydrogen and CO₂ as the new feedstocks.
- The declining use of naphtha as feedstock and its gradual replacement by butane, propane, and ethane from natural gas.
- The need to ensure sensitive and accurate analytical programs for each new process and product to ensure thorough characterization and testing for purity.
- The evolving regulatory standards and global trade standards for existing and new feedstocks and products.

This short list is certain to grow as the industries evolve and new technologies are developed.

Trends in Laboratory Operations

Traditionally, refineries and petrochemical facilities have taken full responsibility for operating their on-site laboratory. The trend today is for the industry to rely on outside companies that have the expertise, global scale and resources to manage and operate the laboratory.

Nearly every new refinery and chemical complex being constructed today includes an on-site laboratory. The logic behind having an on-site laboratory is clear: these new facilities and complexes will analyze tens of thousands of samples each year, and the logistics of getting those samples to an off-site laboratory is inefficient and slows the remedial response time when anomalies or impurities are identified.

The trend of onsite labs managed by an outside laboratory specialist is another strategy being used to improve efficiency, reduce capital employed, increase cost flexibility, and reduce liabilities.
Large as well as start-up companies (e.g. at new Liquefied Natural Gas (LNG) Plants) involve an outside laboratory specialist, a Lab Engineering, Procurement and Construction (EPC) contractor (responsible for engineering, design, procurement, commissioning and start-up of the entire laboratory within battery limits).

Outsourcing the management & operations of the on-site laboratory is a separate and strategic decision. Newly constructed as well as existing facilities are also trending toward retaining outside assistance for laboratory management and operations.

The scope of laboratory operations managed by the external partner should be custom designed to meet each facility’s specific operational and technical needs and requirements.

Conclusion

An HPI company’s analytical laboratory operations will play an important role in helping the company overcome challenges and maintain a solid business foundation. PerkinElmer and SGS are committed to providing cutting-edge technology and expertise to help HPI companies thrive today and into the future.

References


A PerkinElmer Collaborator
www.sgs.com/naturalresources
Visit SGS on LinkedIn

Arjan Praat
Vice President,
Oil, Gas and Chemicals (OGC)
Analytical Services
SGS Natural Resources

Teresa Ruiz-Escribano
Business Development Manager
Laboratory EPC Projects
SGS Natural Resources