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During the CIS Fuels and Lubricants Conference MAY 2013 conference, our Senior Consulting Heino Decker gave a speech on "EFFICIENT, INNOVATIVE LUBRICANT AND GREASE PRODUCTION". In this presentation he delivered a strategic portrait over the perspective on production excellence in lube oil blending, filling and packaging plants and how companies can get ready to address the production excellence.

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EFFICIENT, INNOVATIVE LUBRICANT
BLENDING AND GREASE PRODUCTION

Heino Decker

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Good morning, it's a great pleasure to be with you here in Moscow. Main focus in my speech this morning will be on looking at the longer term trends in lubes technology which will affect our lube oil blending, filling and packaging plants and the significant growth opportunity this region presents.

Those trends in production will include the need to manage volatility, reduce energy and therefor carbon dioxide emissions; and to improve the production technology which will help us meet future needs. In my case study I will give you're an approach about a modern LOBP facility modernization or rebuilding.

But before turning to what may lie ahead, I would like to spend a few minutes looking back over the past year and where we have come from.

1 Introduction

Within a complex economic world the production facility for lube oil blending and grease, filling and packaging must have a design with fits to the needs and requirements of the customers.

One aspect of the plant design is the optimization of capital expansions (CAPEX), operation expansion's (OPEX) as well as maintenance costs and on the other hands to the integration in the supply and logistic of the customer to react fast and cost effective.

When searching for answers to such difficult aspects, many points of view have to be taken into account. In my presentation, I would like to illuminate and discuss the issue of production technology on base of a case study.

I would like to begin with a look at the lubricants.

Mixing base oil and additives produces lubricants. A convectional high performance lubricant contains typically additive components with high concentration of metal organic components based on the establish rules "more calcium, zinc, magnesium and also of course phosphor and sulfur better the lubricants".

There will continue to be a global push to reduce CO2 emission targets for e.g. in the EU the heterogeneous fleet emission targets will go from 160 g/km in 2006 to 95 g/km in 2020.[1] The new stringent emission standards lead to new lubricants with lower ash forming and less sulfur and phosphor contents. Also the new requirements of the car industry on longer oil change cycles, less frictions and optimal wear protection leads to new developments of additive packages.

[1] Source: IEA WEO 2008; Roland Berger

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This low SAPS motor oil (sulphated ash, phosphorus, sulphur) became a construction element for the machineries to cool, clean, prevent corrosion, reduce oxidation and prevent wax crystals forming when the weather is very cold. A mixture for this type of lubricants could contain, beside base oil, up to 20% additives.

The penetration of e.g. low SAPS motor oils will impact lubricant production equipment and creates also range of opportunities for the lubricants producer.

1.1 MARKET SCENARIO

The production of lubricants is distributed 60% on automotive lubricants and 40% on industrial lubricants, like hydraulic fluids, turbines, insulation oil, grease as well as pharmaceuticals. Both segments have different characteristics and strategies. The lubricants have to undergo strict quality tests before they are accepted by the automobile industry. The test procedures are defined by API (American Petroleum Institute), ASTM (American Society for Testing and Materials), and by personalized approvals from the machines manufactories.

The automotive lubricants are more or less consumer products, while industrial lubricants are sold like industrial goods. In the past, the market participants have concentrated mainly on the distribution of mass-products. This trend has changed totally. Today, the marketing and the development of lubricant brands have become more important.

The market development is of course not uniform and is marked with view on production by the following features:

It is a developed market: as in Western Europe, USA and Japan the aim is here to extend as well as to develop the market share. The lube market is characterized by declining consumption what means for production lacks in volume.

The features of these markets are:

- Slow and irregular growth of the home markets
- Growing pressure on production - and marketing costs
- Greater influence of the legislators on business behaviors and Investment decisions
- Intensified competition
- Decreasing of production capacity for lubricants

Success-strategies in these markets are:

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- Achievement of the lowest production cost in comparison to the competition with simultaneous acceptable quality.
- Achievement of the highest practicable product -, service, - and quality differentiation with a view to the competition

And finally it is also a market of changes:
Conversely, consumption in the Asia-Pacific region is expected to grow within the same timeframe, driven by the booming economies of China and India. This is being driven by significant growth in vehicle ownership. But on the other hands the consumption of full synthetic lubes in Europe is the highest of any region.[2]

In Russia as a result of growing passenger traffic and replacement of aging inventory the demand of lubricants increasing from both auto makers and consumers[3]. The Russian market becomes another key target for the global lubes industry by building up production capacities.

Today the Russian market is dominated by group 1 base lubricates formulations. The environmental aspect and modern cars leads to reducing emissions and improving fuel efficiency. That means there will be increasing demand for advanced lubricants production updates to meet the stringent requirements of the modern formulation of lubricates.

1.2 INFLUENCE OF MARKET-TRENDS ON THE LUBRICANTS PRODUCTION

There is constant change in products, production procedures, as well as companies. This trend must also be met successfully in production technology, in order to win substantial and lasting competition-advantages

This complex scenario cannot remain the responsibility of one single department. The perception of the production advantages demand, that all management-levels of the company develop an understanding of the new lubricates technologies, so that the company networking can be used.

This Supply Chain identifies the flow of information and material from the supplier to the customer. There is no better way, at least for the lubricant producers, to positively impact the bottom line, i.e. increased profit through reduction of operating and overhead expenses.

This will be clear when you analyses the relation of profits and production costs. Long-term profits are the result of intelligent product politics (high product output; balanced product portfolio) and from superior marketing. Both are key factors for

[2] Kline's study, COMPETITIVE INTELLIGENCE FOR THE GLOBAL LUBRICANTS INDUSTRY, 2006-2016
[3] Moscow-based RPI's new study, "Actual Engine Oil Consumption by Motor Vehicles in Russia."

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generating profits while lowering production cost and maintaining high product availability.

Product readiness and availability should be improved by proper market forecast together with a synchronized production schedule per unit, two essential elements of an optimized “Supply Chain”. Product availability is not necessarily achieved through higher inventory, which will only increase storage expenses.

If we have a look into the cost structure of a typical lube oil blending filling and packaging plant round 75% are related to row material like base oils and additives, 15% for production and 10% for logistic and working capital.

Reducing operation expenses is the energy driving and must work on the improvement of chain security for raw material > lower tank farm capacity, cost-volume – formulations > blending & filling equipment and production cost per liter lubricants > automation.

1.3 LUBRICANTS BLENDING AND PACKAGING

The fundamentals of „Supply Chain Management“ must be translated into consistent strategies in the area of plant operations. For this reason I will focus on „MAKE“.

From my point of view there are three major „MAKE“ groups due to the worldwide change in the lubricant market, as follows:

a.) The blending center of multi-nationals
b.) The contract blending by multi-nationals without own brand name
c.) The independent manufacturers of lubricants with own brand name

All MAKE-models have one thing in common that lubes manufactures must become more agile to react to business environment.

Investments in manufacturing should be supported by the following essential business aims:

a. Product-variety

According to the market a multiplicity of different recipes are produced in a lubricant blending plant. The numbers of the different recipes vary from approximately 60 in growth-markets up to 600 in industrialized countries. The products are divided in 8-22 product families and are sold in the many different package sizes. The package varies from a 0,5 liter bottle to the delivery of the lubricants in tanks.

b. Increase in productivity

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The productivity is increased by use of a modular production concept. This concept allows a switch on/off production capacity so that they can manage substantial and lasting competition advantages.

c. Raw material diversity

Very simple recipes mainly consist of components from six base oils and some additives packages. The differentiation in the products and applications mentioned at the beginning need, according to product spectrum, between 200 to 300 components. The components are available mainly in containers and drums.

d. Contamination

Production plants are used for the production of many different Lubricants. Contamination between the various products must absolutely be avoided. In the past, separate pipelines were planned or intensive flushing between the recipes had to be done. This necessity limited the flexibility of the blending plant and considerably increased the running costs through the generation of slop oil.

2 Conception

Beside the project-management-theory, it appears important, to give priority to the practice, to outline problems and to discuss solutions.

Let's begin with a difficulty that seems to be a typical technical one, namely the difficulty of the plant constructor to transform the enormous conceptual knowledge of the future oil blending plant from theory into a not always perfect reality.

When dealing with such a complex task, it is essential to exactly describe the information given by the plant constructor, the operator and the process technology in a conceptual design. This phase is very important, since planning mistakes can lead to considerable additional costs if changes are required later.

Some information are needed like product portfolio with type of lubricants and product family; amounts and formulations. Besides of this some marketing information like service level, reaction time, and location helps to understand the expectation of the lube oil blending plant. On the end the supply information about type of raw material gives then a complete picture for the design concept. This design leads to cost effectives by reasonable equipment utilization level, scheduling of capital costs & investment priorities and have a positive impact on Operating Expenses.

Based on a simulation supported planning witch take into consideration formulas, process and system parameters identifies and eliminate bottlenecks before realizing so that the owner can be sure the right decisions in layout and process.

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Particular attention should be given to the utilization of filling layout, since due to the high investment costs, the biggest investment of capital and thus have the lowest production capacities.

As I mentioned before a lubricants blending and packaging must become a MAKE and will be an integral part of the supply chain and should be used also as a marketing tool. The architecture and layout of the plant have to make positive contributions to environmental Impact and energy efficiency across to the production of the high quality lubricants.

The architectural essence should be not only a formal aesthetic idea, but more over it must emerges of diverse optimization of hard and soft factors such as location and also ecology and emotion in a "performance approach".

Some aspect for the architecture must be the communication of the different production teams working in inbound, blending lab, outbound, administration. The other is efficiency and flexibility of the facility. To support the marketing idea the facility must be ecological, aesthetic, as well a modern building technologies supports the identity of the high quality lubricants brand.

3 From Concept to Completion – the overviews of the key-elements of a modern oil blending plant

The delivering the lubricant product performance requirements advanced production technologies. There is a need to dose base oil and additives to a defined value to reach the exact concentration. Out-of-specification results in a quality laboratory require significant resources and time to resolve. To other effect is savings of giveaways by precise dosing.

Questions that arise are: What is the correct dosing device to reach an accuracy and precision of each component if the percentage of components rages from parts per million (PPM) to double count percentages formulation.

Automating the process using different dosing technologies will reduce the potential sources of error and thereby reduce the risk of out-of-specification results.

3.1 IN LINE BLENDER

Large batches (fast movers) are ideal for an in-line blender. With the IN LINE BLENDER 5-6 components are simultaneously and proportional filled in a heater and lead via an inline mixer to the product tank. The signals from these meters would be scaled and totalized by the blender.

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When the required quantity is achieved, all inflow-valves are closed and the batch is completed. Smaller quantities of additives are added into the blender as drum-components or via cocktail-tanks with dosing pumps.

This type of blender is capable of delivering homogeneous, on-test product directly to a finished product tank with no requirement for additional mixing.

3.2 AUTOMATIC BATCH BLENDER (ABB)

A batch blender: The old principle; that secures the thesis "a kilogram is a kilogram" with modern technology.

The AUTOMATIC BATCH BLENDER based on weighing technology is profitable for economic batch sizes of less than 15-25 Mt and could be used for the slow mover products.

As during the dosing of the components a very effective mixer is running continuously, the product is homogenized shortly after dosing the last component. The operator can manually add smaller components to the weighing container. The finished product is then pumped directly via pigging lines in holding-tanks, analyzed and filled in finished product units via filling lines.

3.3 SIMULTANEOUS METERING BLENDER (SMB)

With an economic batch size between 20-70 metric tons the use of SIMULTANEOUS METERING BLENDERS could be considered as the best thing.

The SMB is a functional combination of an Inline Blender by using mass flow meter and sequential dosing of components.

When skillfully combining the products at equal dosing times, fewer mass flow meters, pumps and machines are required and the SMB could be used in combination with the batch blender for a wide range of formulation.

3.4 DRUM DECANTING Unit (DDU)

To achieve a high accuracy and precision also for components in the range of some percentages other dosing devices must be used.

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Most of the additives are delivered in drums. The available number of additives for various grades is increasing. Therefore, special attention is placed on the handling of additives in the production process.

With the help of an automatic DRUM DECANTING UNIT where the drums are weight on a high precision scale, emptying drums containing high viscosity additives is possible within a very short period of time.

3.5 PARTS PER MILLION (PPM) COMPONENTS

For the very small components as part of the formulation a dosing pump or a manual scale could be a suitable solution.

3.6 PIGGING EQUIPMENT

Increasing demands on flexibility of lubricant blending plants lead to ever -higher demands on the cleaning of the product-leading pipes and instruments.

The lubricant installations are mostly designed as "multiple product- / multiple line plants". High flexibility in the production can only be reached by avoiding contamination of the different products. Most pigging systems in the lubricant plant cannot be emptied completely to reach this quality aim.

Remaining products in the pipelines cause deposits, which must be avoided at any cost. Costly cleaning cycles with base oils as the cleaning product become necessary.

With the help of pigging equipment a considerable amount of money can be saved.

3.7 AUTOMATION SYSTEM

To remain competitive in lubricant production generally requires high quality automation systems. The automation of production plants has constantly advanced in recent years by the use of control systems. Often, for management information systems with economic and administrative tasks in lubricant blending production, the automation task remained unresolved. This has made a ‘just-in-time’ production more and more difficult.

The aim of state-of-the-art automation concepts is, to see the production as whole, in order to reach universal solutions for the total business. This guarantees the Flow of information between the commercial production planning systems and the process control system, which is oriented towards the production process.

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3.8 FILLING SYSTEMS

The filling area is where the lubricants became its final shape. to handle the complexity in the filling area some principle should be taken into account:

• Product grouping – the Stock keeping Units (SKU's) must be analyzed into product groups which all have a similar packaging type. These groups can then be prioritized based on packaging complexity and minimum change over times for the filling machine.

• Pareto principle (80:20) – This method is based on the premise that 80% of packaging handled by the filling area associated with the top 20% of the production (fast mover).

At the time of filling the filling machine products, expected product temperature is approaching 35°C.

The typical system configuration consists of charging for empty bottle unscramble machine, labeling machine, filling point machine, capping machine, quantity / volume control, laser marking / batching machine, cartooning (erector, labeling, robotic loading, and sealing) and pallet leveling. The process from start to unscramble pallet leveling is done by an automated system for the fast mover and could be more manual for slow mover products.

The system will be supported by automatic counter for the number of wrappers and for the number of cartons. Record the amount of packaging will be supplied to plant control system to connect the blending area with the filling and packaging plant.

The process of filling is done by minimizing / eliminating flushing in the filling machine (self-draining).

3.9 WAREHOUSING

According the service level defined from the supply chain management a sufficient space for many products and raw materials is needed. The warehouse management should make every effort to meet the continuing demands and guarantee a well-organized warehousing and short delivery times of lubricants.

The warehouse should be designed with the ease of operation and implementation of the FIFO (firs in firs out) and IT controlled warehouse management. In the conventional warehouses goods can be stored on palettes, in the drive-in or on flow racks.

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4 FUTURE ASPECTS OF PRODUCTION WITH DMB TECHNOLOGY

After more 30 years lubricants production we face with the new lubricates the need to redesign the core competence of a lube oil blending plant MIXING and the related process technology.

It is recognized that conventional production techniques like ABB, ILB, … do not complete suffice for modern and technologically more advanced lube oil products.

Due to the complexity of the new generation of lubricants with partly solid additives and partial emulsion character as a central building block a dispersing machine was chosen. This principle we call Dispensing Mixing Blender (DMB).

Against the background of the work considered to raise new questions. Sun now, the age stability of the lubricant systems could be analyzed in a completely different way.

The use of emulsifiers for the production can generate completely new performance characters. We can control the lubricants drop size in the rage of some micrometers and existing filter systems could be redesign based on the new fact findings. Besides of the improvement of product quality we save significant energy cost in production and also gain production capacity.

5 Summary

The combination of the available tools like DMB, ABB, SMB, ILB adapts optimally to the production demands that are prescribed by the market which is given by the simulation. After 30 years within the simple stirred tank was used, the DMB technology is a significant step in the appeal of the production technology for high-tech lubricants.

Present-day oil blending plants are sophisticated, smart and contain very modern control systems. In order to fulfill the market requirements, a high efficiency is necessary. The key element for this requirement is flexibility to support the players to following there distinct approaches to the market-place . . .

Flexibility is defined in the conception-phase and determined in Basic- Engineering. With the use of computer-aided planning-methods and standard tools a cost-effective design can be achieved for new investments and revamps.

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Biodata

As the Senior Manager for Philips, Mr. Decker was responsible for worldwide consulting and engineering services, as well as for the design and realization of lubricants plants. During his tenure with Philips, Mr. Decker focused on research and development of new processes and technologies to improve lubricants and holds German Patents for this field.

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