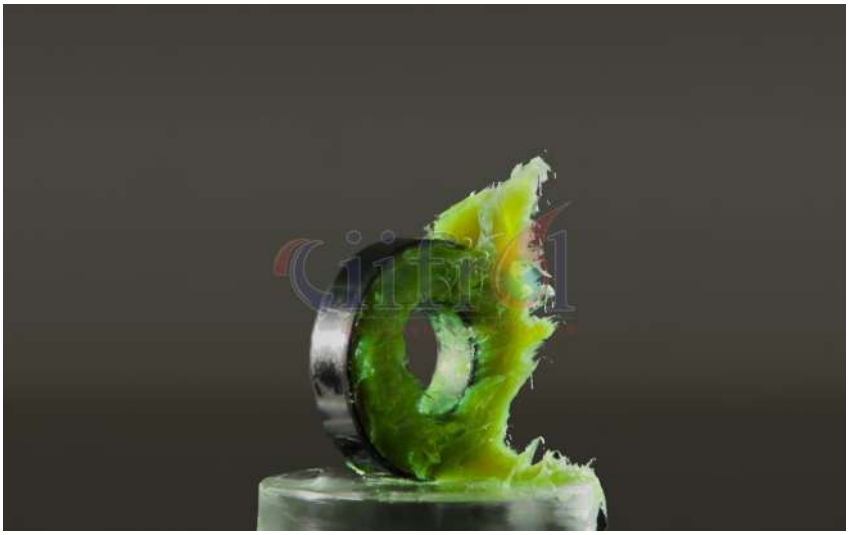


STUDY OF MANUFACTURING PROCESS OF GREASE

@ Ciif Lubricants plant at Silvasa, Gujarat, India

ABSTRACT

Understanding chemical reaction and importance of various stages of grease manufacturing process by visiting grease manufacturing plant under guidance of Mr. Avinash Deshmukh, Startup Consultant and Ex-VP with Ciif Lubricants Pvt Ltd.

By: Khushi Dave

Introduction:

For over 4,000 years, man has made use of solid or semi solid materials for lubrication. During this time, many methods have been used for their manufacture.

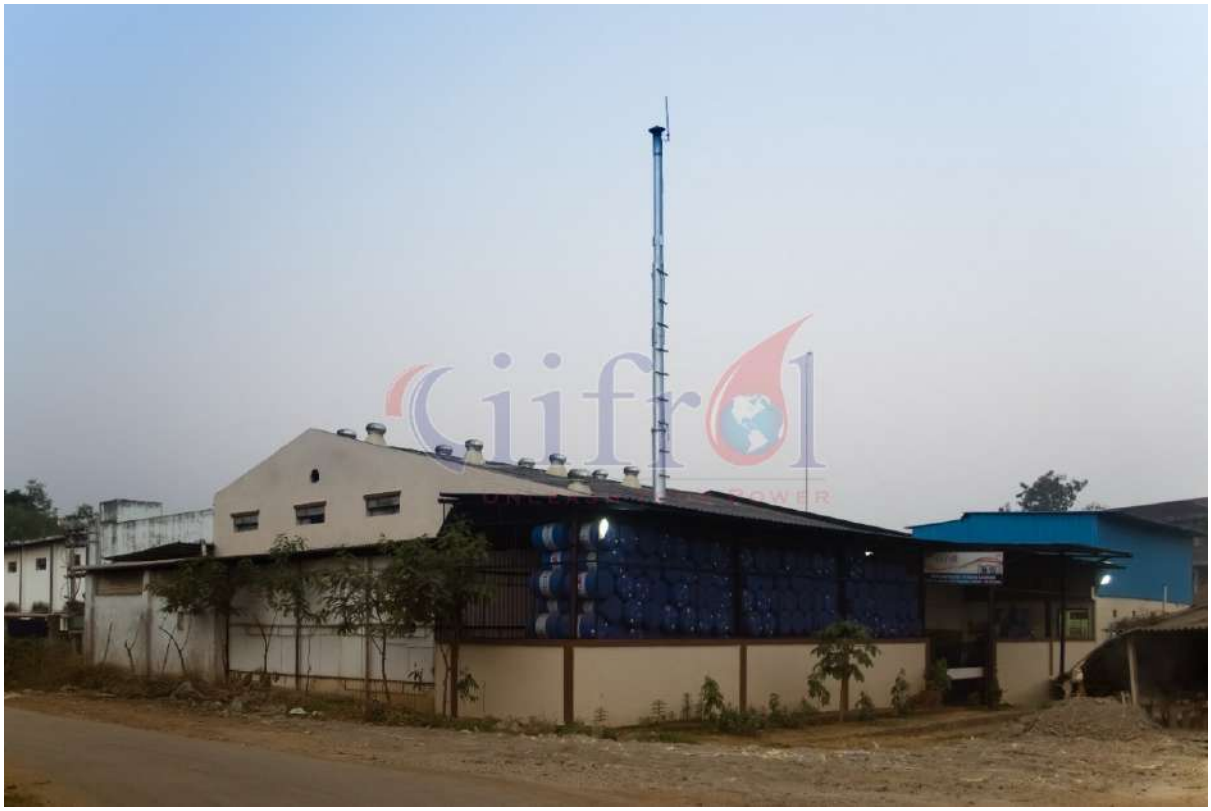
In order to reduce the friction and wear between surfaces in high pressure and temperature engines and machines, low viscosity and dropping point lubricants are not preferable. Grease lubricants are higher viscosity and dropping point lubricants. Grease is one of the old petroleum lubricants over the world (Totten, et al. 2003). Grease can be described as a semi-fluid to solid, multi-color lubricant.

The primary component of grease is the fluid lubricant that can be a petroleum oil, vegetable oil, and synthetic oil. Lubricant fluid identifies the lubrication quality of the grease. The other ingredients that uses in grease manufacturing are thickener and additives (Kholijah, et al. 2012).

Typically, a grease might contain 85% base fluid, 10% thickener and 5% additives.

The multiphase grease structure gives the product a suitable consistency which enables the grease to remain in place under the conditions of use. This ensures effective lubrication, provides a sealing capability and enables the grease to position functional additives close to the working surfaces of the equipment. Depending on the shear conditions at the moving surfaces, the grease will deform and flow to provide lubrication and then regain its structured consistency as the shear decreases.

In order to understand the grease manufacturing process better, I visited Silvasa Plant of Ciifrol Lubricants, under guidance of Mr. Avinash Deshmukh, a Startup Consultant and Ex-VP at Ciif Lubricants Private Ltd at Silvasa, Gujarat, India



Picture 1: Grease Manufacturing Plant of Ciifrol Lubricants, Silvasa, Gujarat, India

GREASE MANUFACTURING PROCESS

A typical grease manufacturing process at Ciifrol Manufacturing unit at Silvasa consists of following key steps

1. Feed Stock Preparation
2. Saponification Reaction
3. Processing Reactor
4. Cooling / Finishing Kettle
5. Quality checks
6. Packaging and Dispatch

Picture 1: Grease Manufacturing Unit, Ciif Lubricants, Silvasa

Step 1: Feed Stock Preparation

a. Base Oil

Bright base oil is lubricant oil has been used as base oil for grease production. It is paraffinic oil, produced from vacuum distillation residue after removal of asphalt. Below table shows some of base oil's properties

Parameter	Test Method	Observation / Report Value
Appearance	Visual	Br. & Clear
Density @29.5° C	D 1298	0.8801
Colour	D 1500	L 2.5
Flash Point; (COC) ° C	D 92	242
Pour Point ° C	D 97	-6
Viscocity index	D2270	96.4

b. Lithium Hydroxide (LiOH)
of them are in solid form with good purity degree and suitable for industrial purpose.

c. Stearic Acid (C17H35COOH)
Stearic acid is a long chain fatty acid and it is used as solid. Mainly derived from castor oil in hydrogenated form

d. Additives
20% Bismuth Ten-Cem® (rust inhibitor and corrosion inhibitor).
1- Dioctyldiphenylamine (Antioxidant).

A typical composition of feed stock was as in below table:

Material	Typical Percent Contribution
Base Oil	86.25%
Lithium Hydroxide	1.75%
Stearic Acid	10%
20% Bismuth Ten-Cem®	1.4%
Dioctyldiphenylamine	0.6%

Table2. Feed composition and amounts Materials

Step 2: Saponification reaction and reactor:

Grease forms after thickening of the base oil by thickener. The thickener in grease production is formed in situ by the saponification reaction. The saponification reaction involves, metallic base LiOH with fatty acid (Stearic acid) to produce the soap (thickener). The reaction is endothermic reaction and needs heating.

Reactions:

$C_{17}H_{35}COOH + LiOH \longrightarrow C_{17}H_{35}COOLi + H_2O$ (Lithium grease)

Production of Lithium Lubricating Grease:

Grease plant consists of a high pressure, jacketed mixed flow reactor. Saponification reaction takes place in this reactor, then the base oil and additives are added to produce grease s in the finishing kettle

Very rapid heating during saponification occurs when the ingredients are circulated between the circulation tube and the shell. A heat rise from ambient to 400°F (204°C) will occur in 60 minutes. Saponification times vary, however, 30 minutes at 400°F (204°C) is usually sufficient to affect complete reaction of the fatty acid and alkali in the oil medium As the saponification reaction proceeds to completion, water is generated as a by-product of the chemical reaction.

Picture 2: Saponification Reaction Kettle

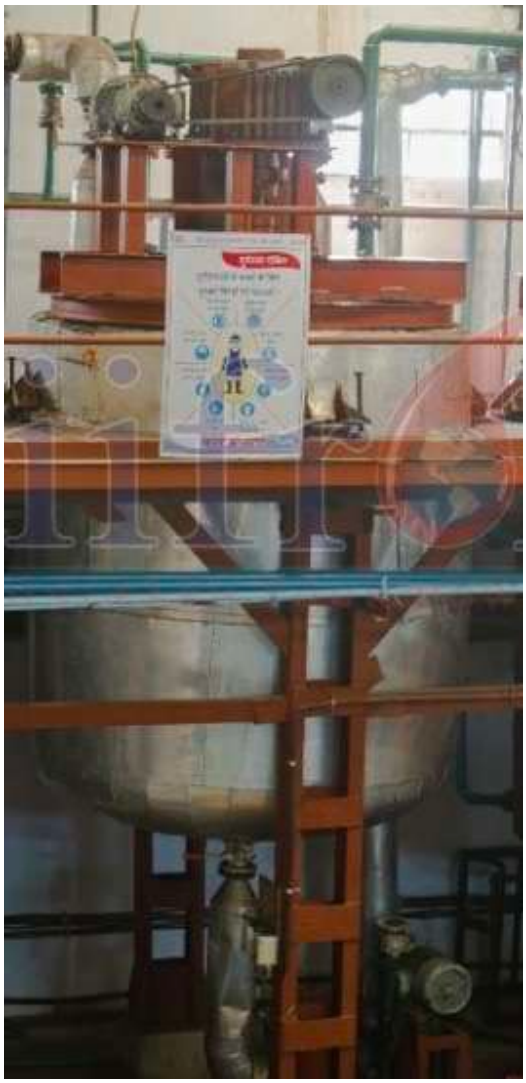
Step 3: Processing Kettle

At this stage the reactor is depressurised to remove excess water in form of water vapours and the soap is dehydrated

Kettles:

The design of kettles for the manufacture of lubricating grease has been improved over the years. The outer shell surfaces of the kettle are usually jacketed for heating and cooling of the kettle contents. The heating medium is normally hot oil designed for 75 psig (517 kPa) at a maximum temperature of 500°F (260°C).

At 390°F (199°C), the soap is entirely fluid. As the temperature is lowered to 330°F (166°C), the viscosity begins to increase. At approximately 315°F (157°C), the gel structure begins to form. To maximize yield, the grease maker will add the dilution oil rapidly until the grease temperature is reduced to 330°F (166°C). At this point the rate of oil addition will be reduced until the grease has gelled. After gelling, the remainder of the oil is added rapidly.



Picture 3: Top Mounted Motor Grease Kettle

Step 4: Cooling / Finishing Vessel

As the grease cools, the viscosity increases, which in turn, increases the power input from the impeller. This added energy goes into the grease as shear which causes a very uniform dispersion of finely divided soap particles. By reducing the temperature of the soap, the grease maker can maximize the yield of product and reduce the necessity for further milling of the grease.

Thickeners

Developments in thickeners have been fundamental to the advances in grease technology. The contribution of thickeners has been so central to developments that many greases are often classified by the type of thickener used to give the structured matrix and consistency.

The two principal groups of thickeners are metal soaps and inorganic Soap based greases being by far the most widespread.

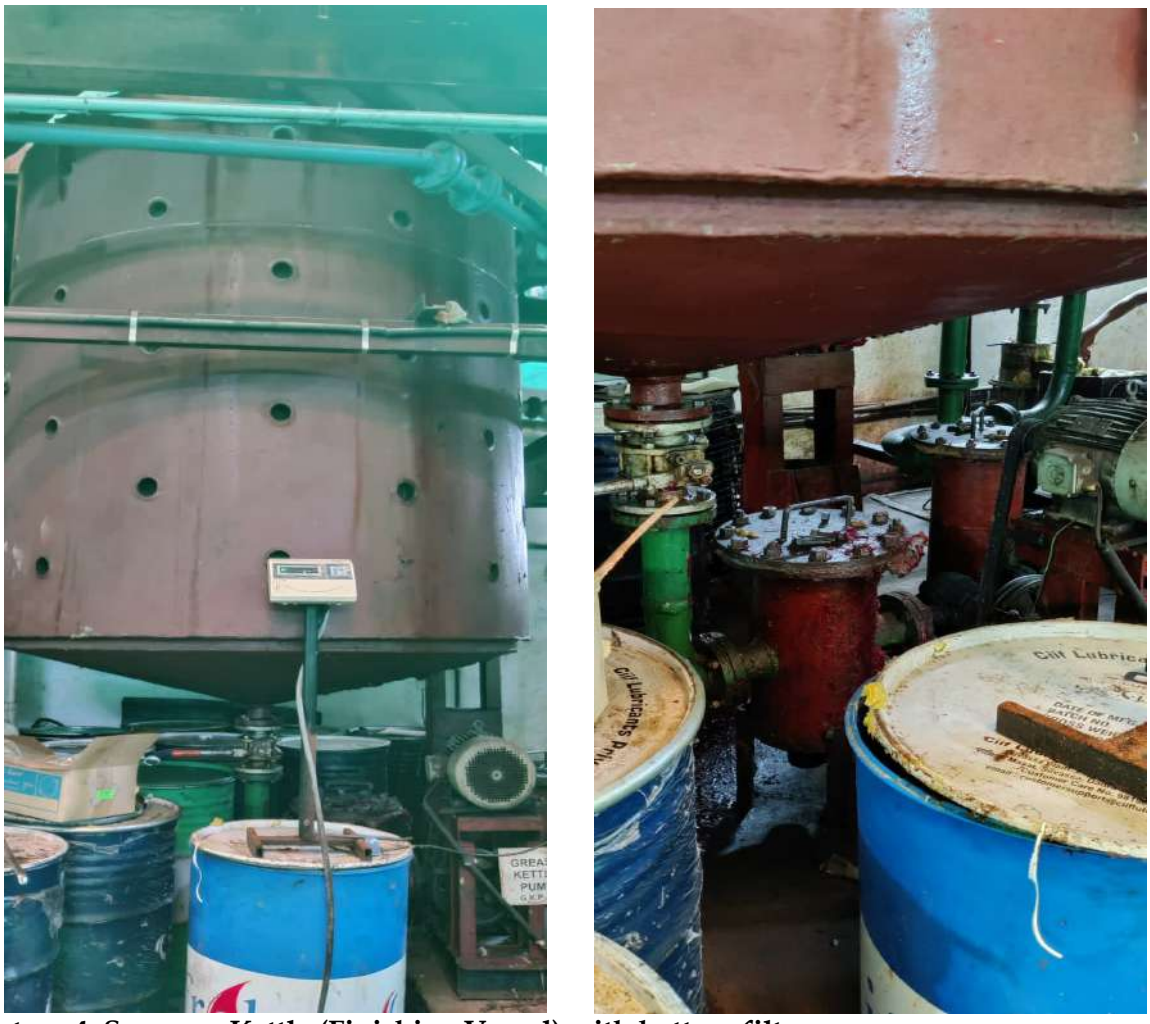
Thickener is a salt of long chained fatty acid, such as Lithium Stearate, that is produced through saponification reaction of metallic base likeLithium hydroxide with long chained fatty acid like stearic acid. Thickener gives grease its properties such as water resistance,

dropping point, etc. In addition, thickener in grease determines grease type, for example if the thickener is Lithium Stearate grease type will be Lithium grease (Manual Engineer, 1999).

In the industrialised world, approximately 70% of the grease consumed today is based on thickeners using lithium soap.. The patented inventions of Clarence Earle in the 1940's have been developed into the traditional and complex soap thickeners which are currently in use.

Inorganic and Other Thickeners
Solids which are essentially insoluble in the base oil can also be used as thickeners in grease formulations. Bentonite and hectorite clays, silica gel, polypropylene, polyethylene and polytetra- fluoroethylene (PTFE) have all found applications.

Additives:
The third component of grease is additives. Additives improve performance of grease and protect the lubricated surface. Additives can be anti- oxidant, rust inhibitor and others, such as molybdenum disulphide or graphite

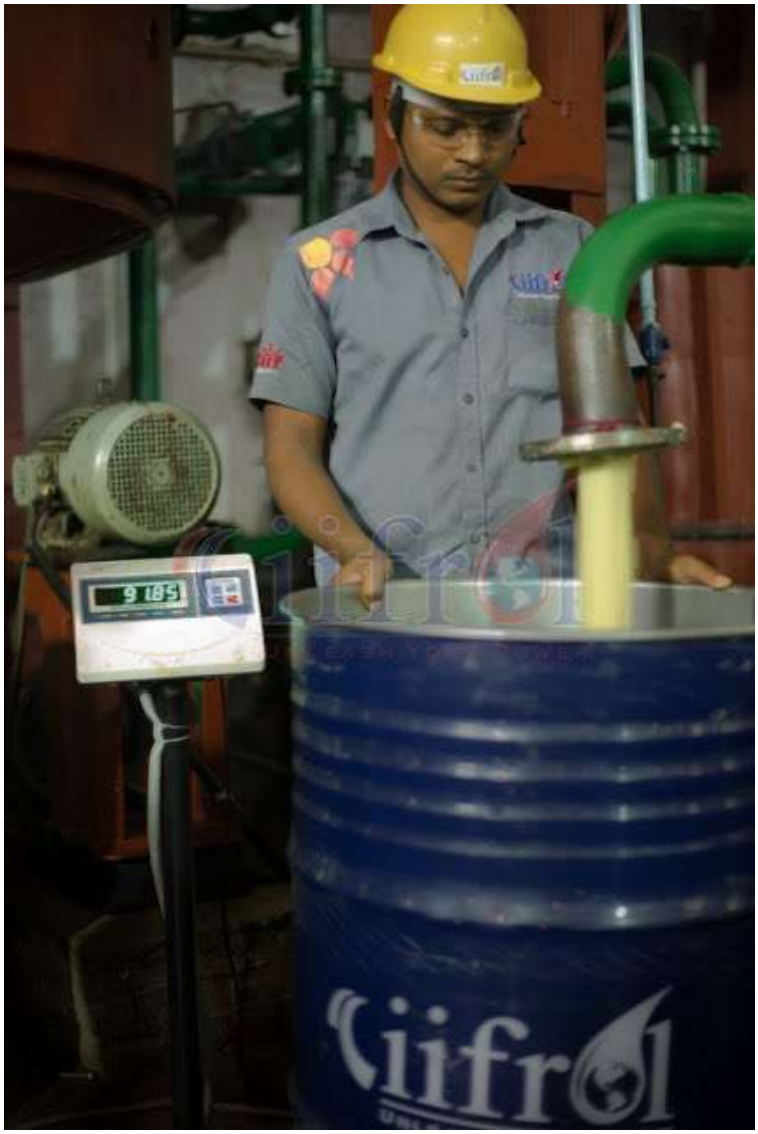


Picture 4: Scrapper Kettle (Finishing Vessel) with bottom filter

Jacketed mixed vessel is used for cooling produced grease by cold water. Also, it offers a further mixing to homogenize the grease.

The process of Homogenisation breaks soap crystals to make grease smooth. Further the temperature of grease is lowered and required additives are included.

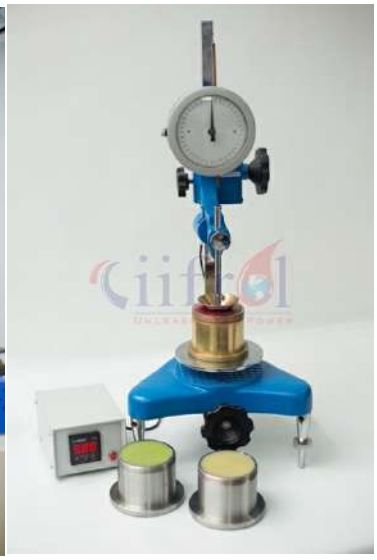
The grease is transferred to a finishing kettle for a final dilution, testing and any additive blending that may be required. . The high intensity mixing of the impeller causes the additives to be more uniformly dispersed throughout the grease.



Picture 5: Grease stored in drums for packaging

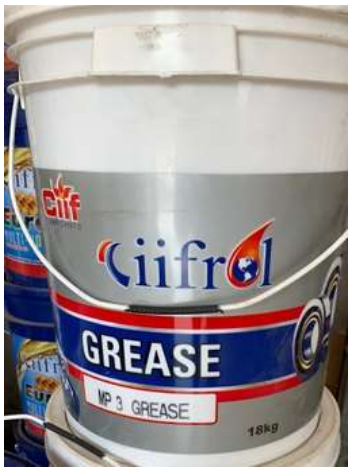
Step 5: Quality Checks:

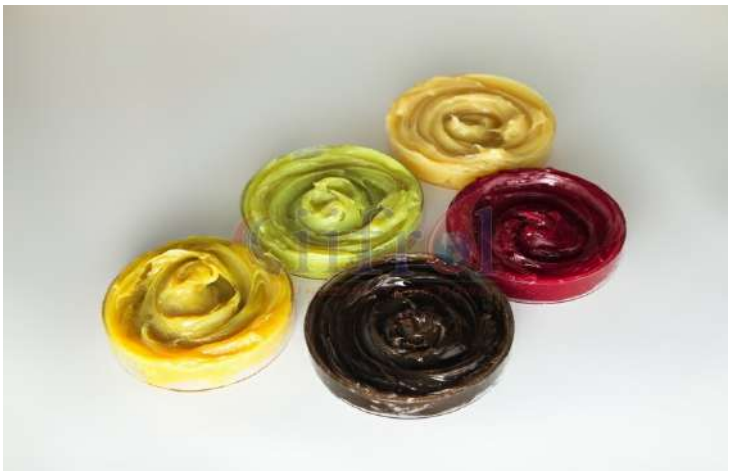
Grease is subjected to quality checks in order to ensure right properties like Penetration or Softness through quality control instruments like Penetrometer. Higher the reading of penetrometer, more is the softness of grease.



Picture 5: Quality Control lab and Penetrometer

Finished Product:

After all required quality control clearances, the grease is packed and dispatched. As said by my guide Mr. Avinash Deshmukh, ***"Traditionally grease as a product gets associated as dirty one, but we at Ciifrol not only make quality product but also make it look beautiful for our customers"***




Picture 6: Finished product: Grease


Picture 7: My guide Mr. Avinash Deshmukh with Ciifrol Lubricants range of products