HARDCASTLE PETROFER
industrial oils and chemicals

New Generation High Performance Deephole Drilling Oil

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ABSTRACT

Mineral oil based Lubricants are being utilized in all sectors of industry for deep hole drilling and all other machining operations. There is an advancement in technology of machine designs to cater stringent quality & cost which evolves requirement of high performance lubricants with environmental favourable requirements.

Development of new generation product is fortified with ester and performance additives to meet requirement such as increase in biodegradability, renewability and substantial performance improvements on deep hole drilling operation.

This study covers our findings that substantial performance improvements on drilling applications can be achieved with the new generation product.

INTRODUCTION

Deep hole drilling is defined as drilling a hole of depth greater than ten times the diameter of the hole. These types of holes require special equipment to maintain the straightness and tolerances. Other considerations are roundness and surface finish.

Deep hole drilling is generally achievable with a few tooling methods, usually gun drilling or BTA drilling. These are differentiated due to the coolant entry method (internal or external) and chip removal method (internal or external). Using methods such as a rotating tool and counter-rotating work piece are common techniques to achieve required straightness tolerances. A high tech monitoring system is used to control force, torque, vibrations, and acoustic emission. Vibration is considered a major defect in deep hole drilling which can often cause the drill to break. A special coolant is usually used to aid in this type of drilling.

The selection of alternative cutting fluids in machining operation gives the better lubrication and cooling effects between cutting tool and work piece with chip evacuation during machining operation. Hence the influence of generated heat on cutting tool would be prevented. The selection criteria of cutting fluids for various material machining processes have been determined according to cutting tool materials.

Modern developments have lead to introduction of advanced in combination of mineral and ester based stocks which have improved wettability, lubrication, high cooling power, rust inhibiting and effective chip evacuation properties. Further they have the added attraction of being natural, non-toxic, biodegradable and relatively non-polluting and cost economical. In the present study an attempt has been made to introduce new generation drilling fluids with enhanced performance.

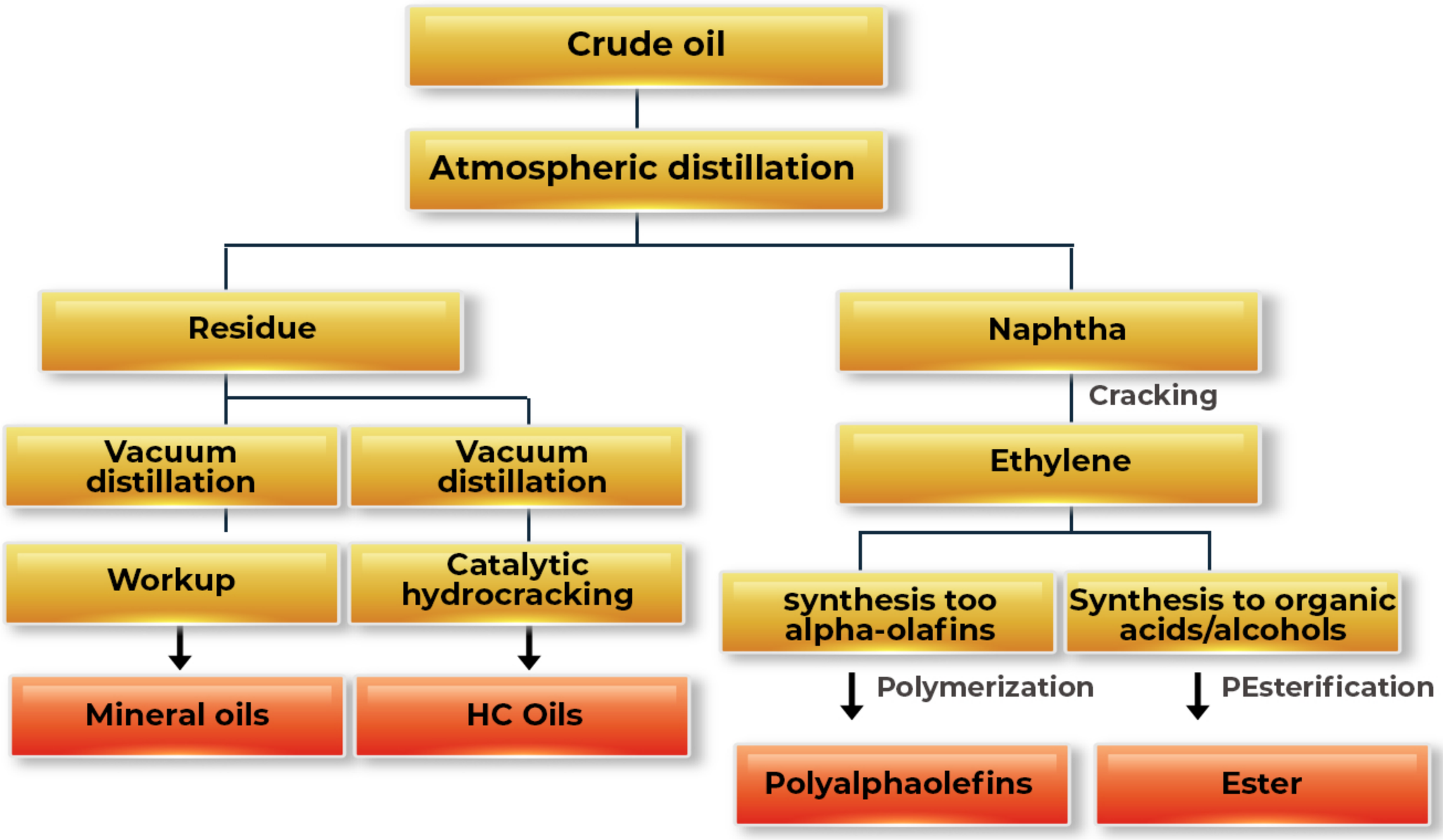
BASE OILS

Base oils are used to manufacture products including lubricating greases, motor oil and metal processing fluids. Different products require different compositions and properties in the oil. One of the most important factors is the liquid's viscosity at various temperatures. Base oil is produced by means of refining crude oil. This means that crude oil is heated in order that various distillates can be separated from one another. During the heating process, light and heavy hydrocarbons are separated – the light ones can be refined to make petrol and other fuels, while the heavier ones are suitable for bitumen and base oils. Different type base oils & manufacturing process illustrated below.

Base oil Categories & Properties

	API BASE OIL CATEGORIES				
	BASE OIL CATEGORY	Sulfur (%)		Saturates (%)	Viscosity Index
Mineral	Group I (solvent refined)	> 0.03	and/or	< 90	80 to 120
Mineral	Group II (hydrotreated)	< 0.03	and	> 90	80 to 120
Mineral	Group III (hydrocracked)	< 0.03	and	> 90	> 120
Synthetic	Group IV	PAO Syntehtic Lubricants			
Synthetic	Group V	All other base oils not included in the above groups			

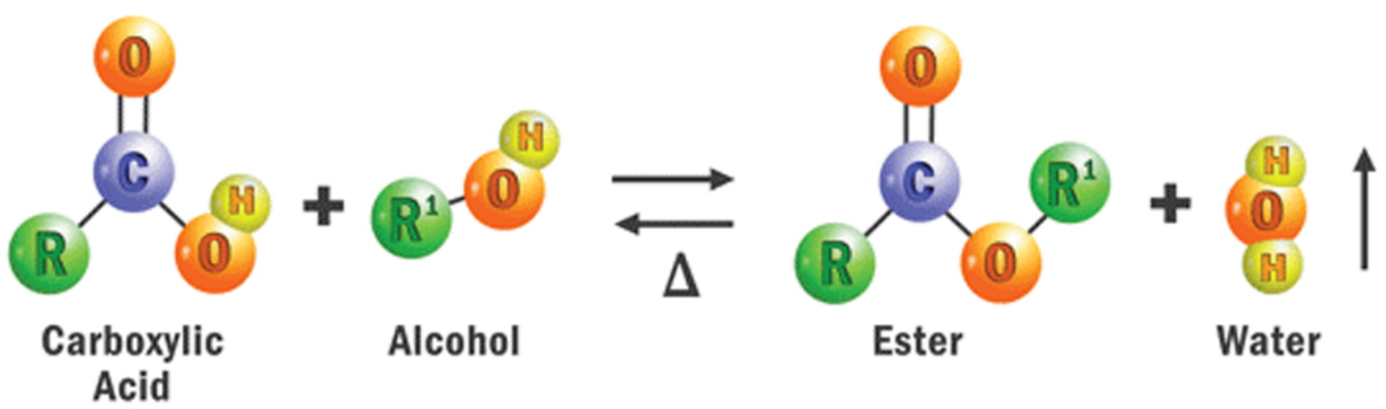
Different Base oil manufacturing process



ESTERS

Esters are derived from carboxylic acids. A carboxylic acid contains the -COOH group, and in an ester the hydrogen in this group is replaced by a hydrocarbon group of some kind. This could be an alkyl group like methyl or ethyl, or one containing a benzene ring like phenyl.

In general, Esters used in lubricant formulations fall into one of two categories: either naturally produced triglycerides from vegetable or animal sources, or synthesized esters developed by combining acids and alcohols in a manufacturing process. Triglyceride esters do have a high viscosity index to minimize thinning at high temperatures, and they exhibit high lubricity.



Properties Of Conventional Oil Vs. New Generation Oil

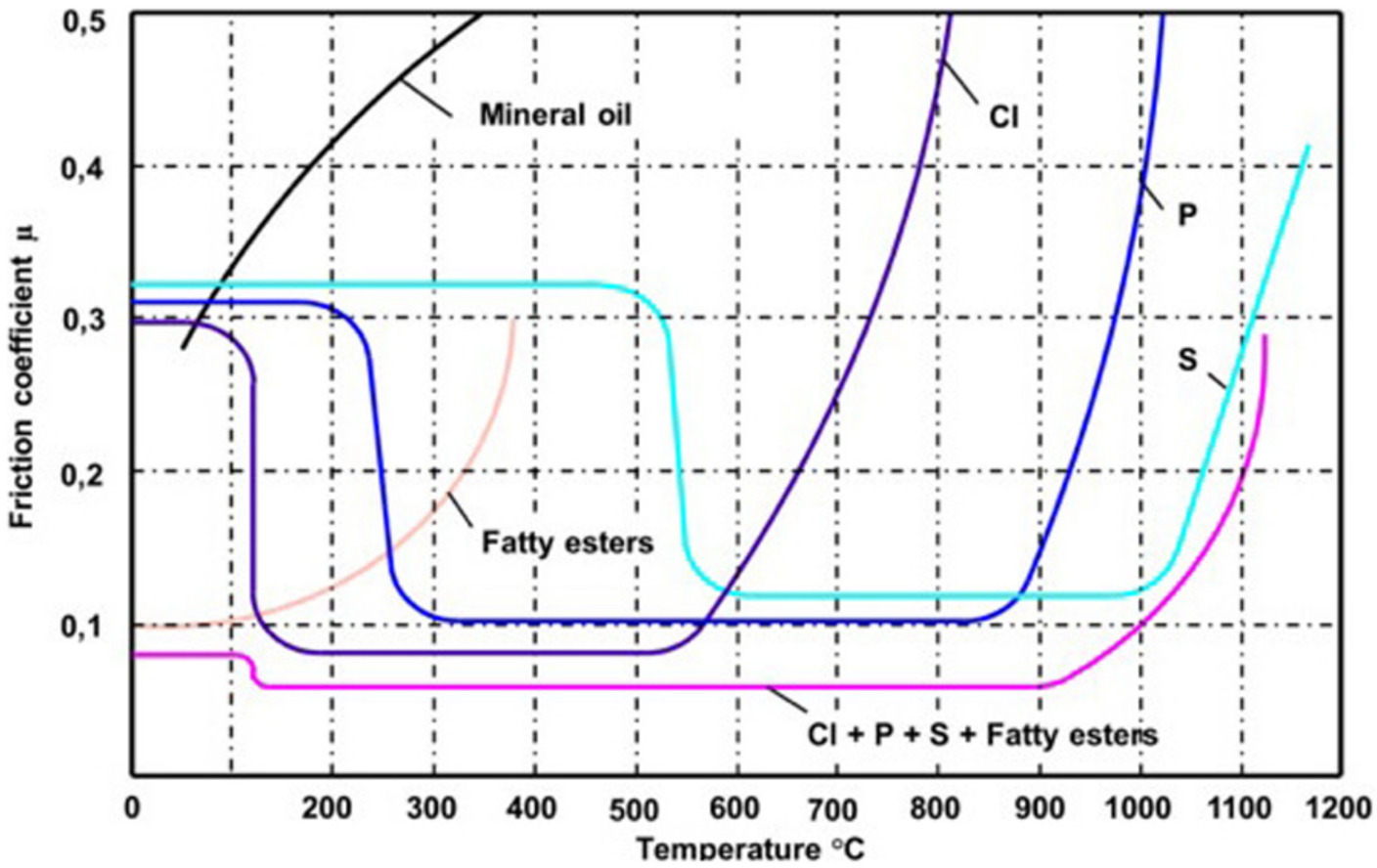
Characteristics	Conventional Oil	New Generation Oil
Lubricity	Good	Excellent
Flash Point	High	High
Viscosity index	Low	High
Low Temperature Properties	Moderate	Good
Low Volatility	Moderate	Good
EP Weld Load	High	High

Advantages of Ester based Cutting oil

Drilling Application types

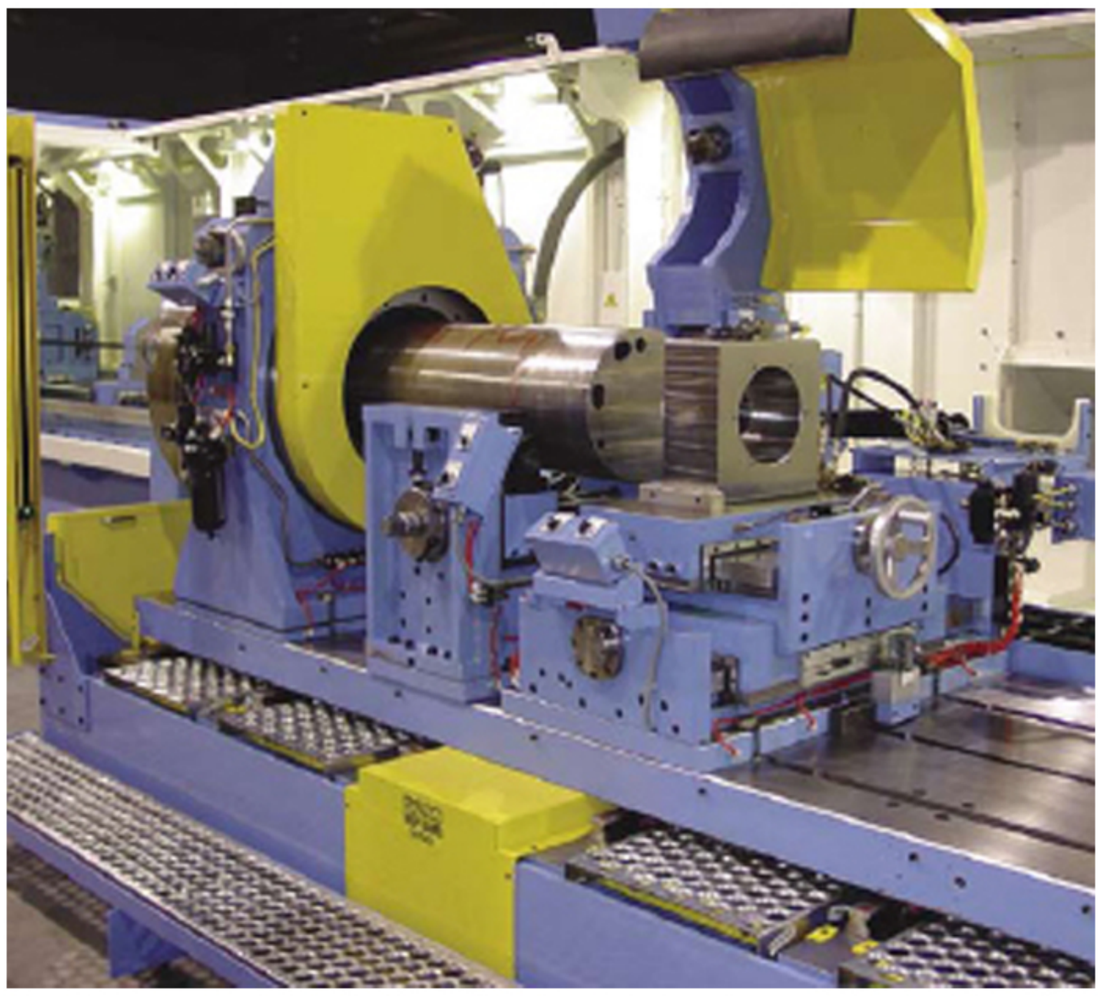
Techinque	Max Depth	Notes
Normal	< 5 Diameters	
Peck Drill	5 - 7 Diameters	
Parabolic Flutes	7 - 20 Diameters	
Custom Cycles	Case-by-Case	Special G-Code & Through Spindle Coolant
BTA Drills	200 - 400 Diameters	Larger Diameter Holes: 20 - 200mm. 5 - 7 times faster than gun drilling
Gun Drills	200 - 400 Diameters	Smaller Diameter Holes: 1 - 50mm

Friction Coefficient For Different additives

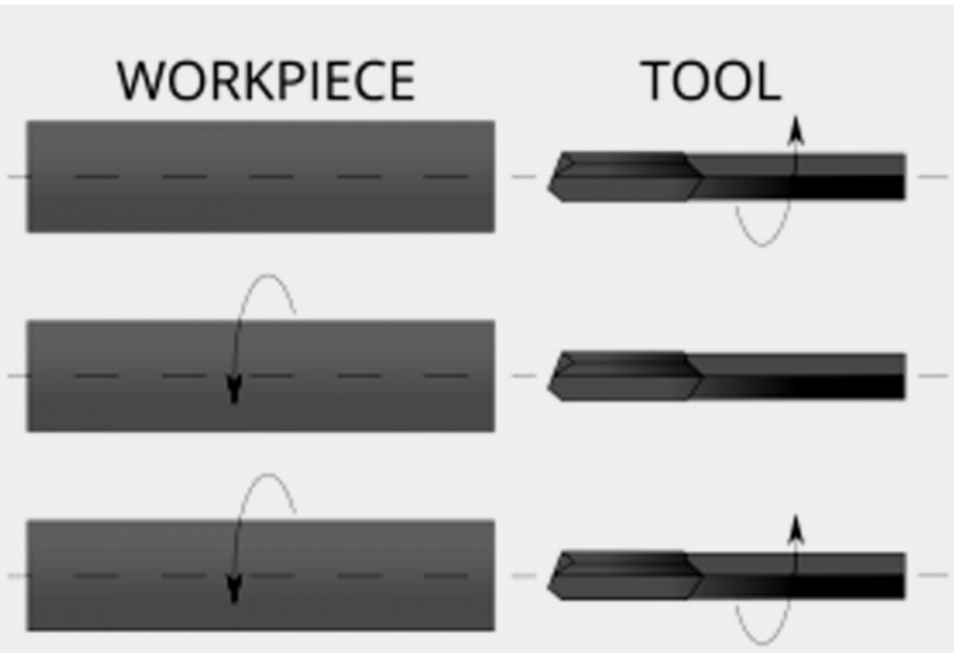


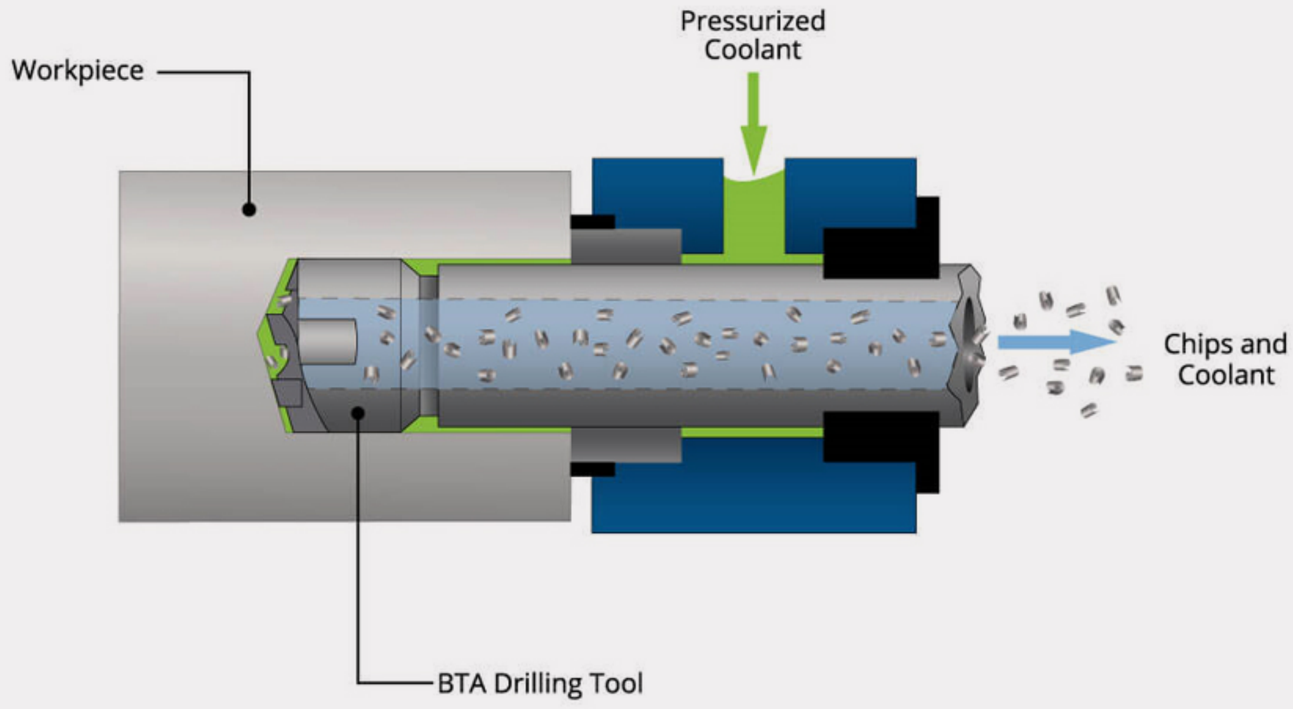
Deep Hole Drilling / Gun Drilling

Deep hole drilling involves the use of gun drilling, BTA drilling and ejector drilling, with additional processes designed specifically to meet very narrow tolerance limits and allow a high degree of precision and accuracy. The BTA-System is a deep hole drilling system for special deep hole drilling machines with an external coolant supply and an internal chip removal (single tube system). Necessary for supplying the coolant to the work piece and for sealing off the process on work piece and boring bar, requires the BTA-System a pressure head.



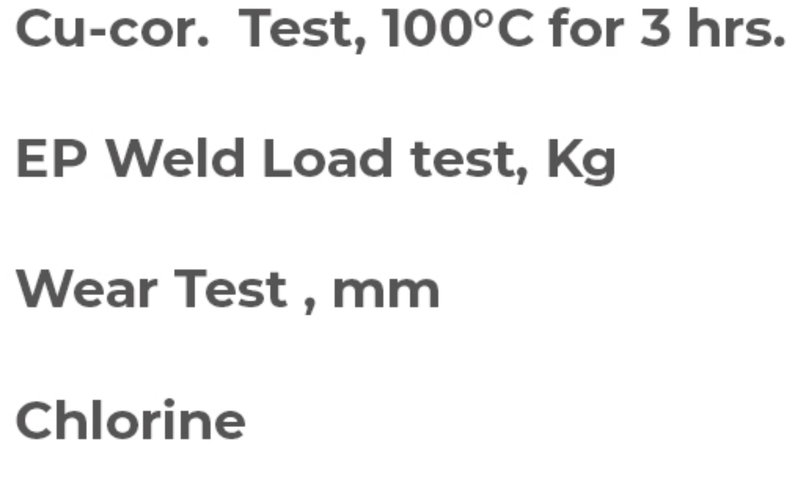
The selection of alternative cutting fluids in machining operation gives the better lubrication and cooling effects between cutting tool and work piece and cutting tool and chip during machining operation. Hence the influence of generated heat on cutting tool would be prevented. The selection of cutting fluids should be carefully carried out to obtain optimum result in machining processes. The selection criteria of cutting fluids for various material machining processes have been determined according to cutting tool materials.

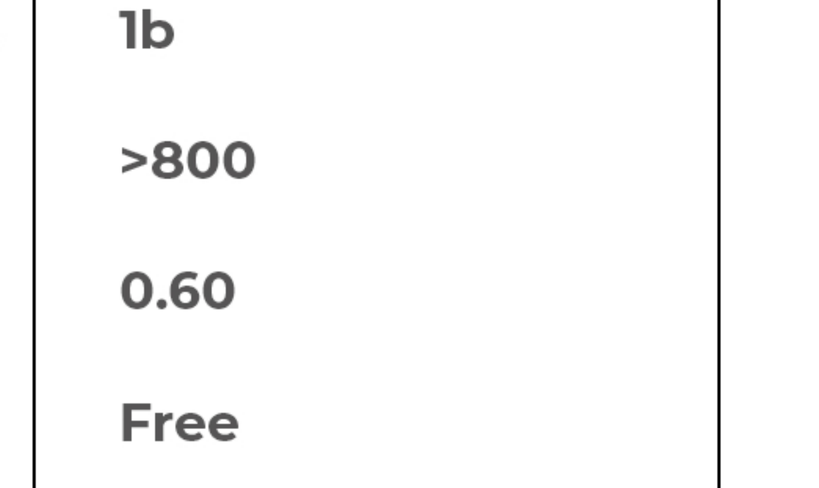


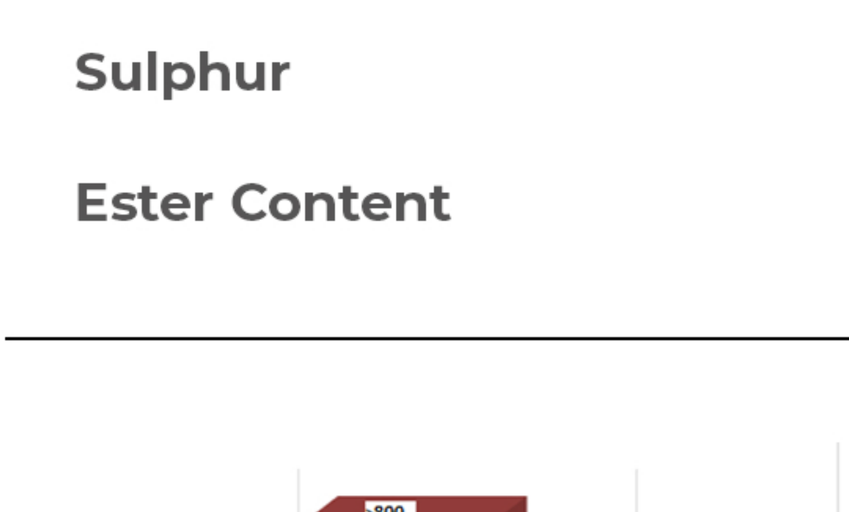


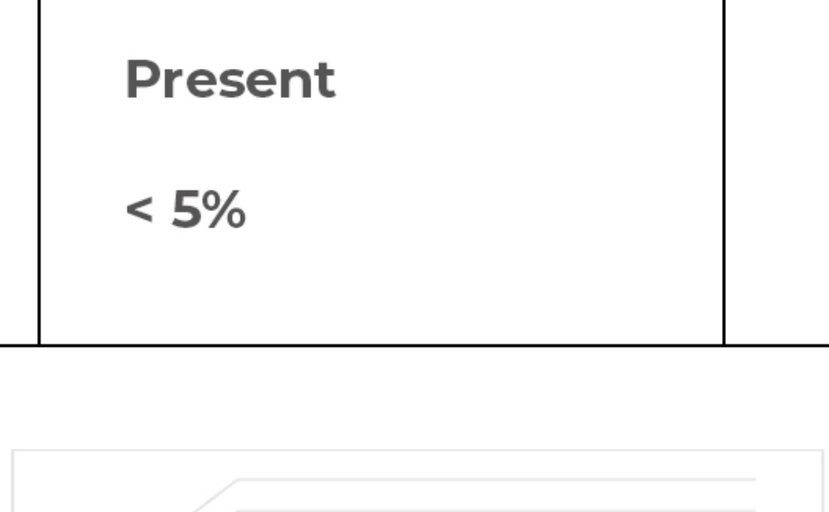
Comparison Between Mineral Vs. Ester Based product

Parameters	Conventional oil	New Generation Oil
Colour, Visual	Brown	Brown
Appearance	Clear oil	Clear oil
Specific Gravity @ 30°C	0.86	0.86
K. Viscosity @ 40°C,cSt	20-24	22-24
Viscosity Index	130	180
Flash Point, COC,°C	180	180
Cu-cor. Test, 100°C for 3 hrs.	1b	1b
EP Weld Load test, Kg	>800	>800
Wear Test , mm	0.60	0.36
Chlorine	Free	Free
Sulphur	Present	Present
Ester Content	< 5%	< 50 %



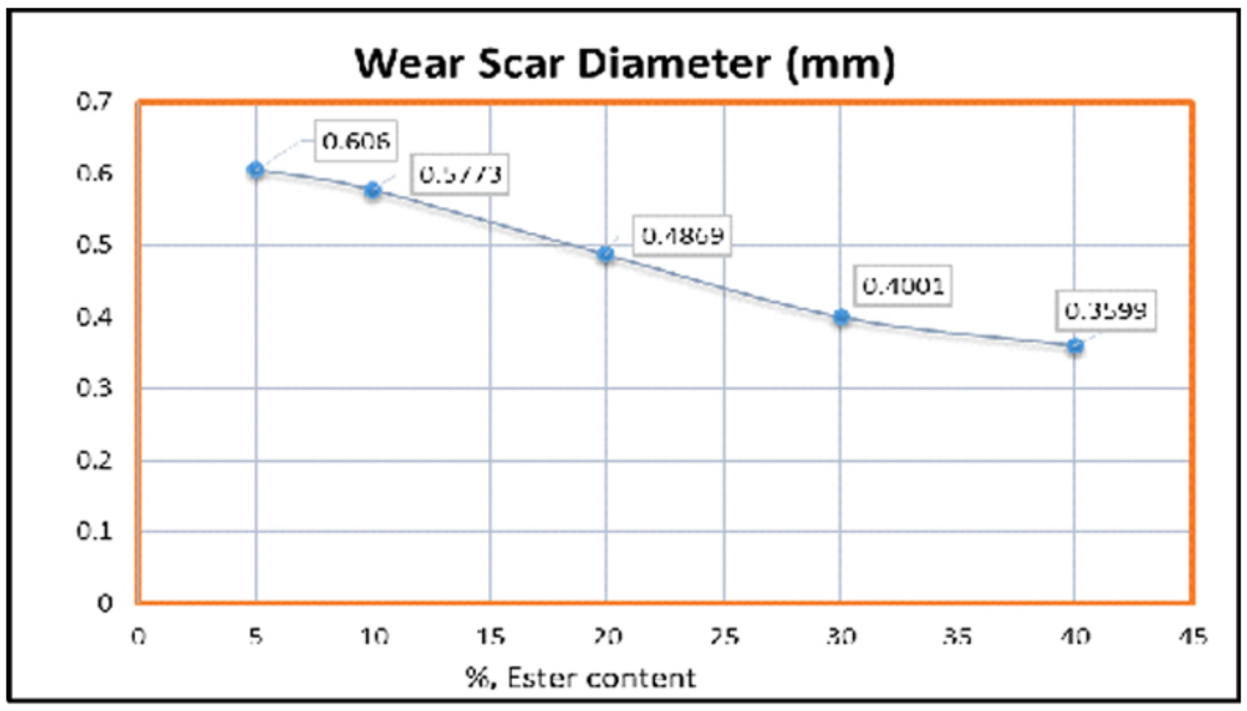


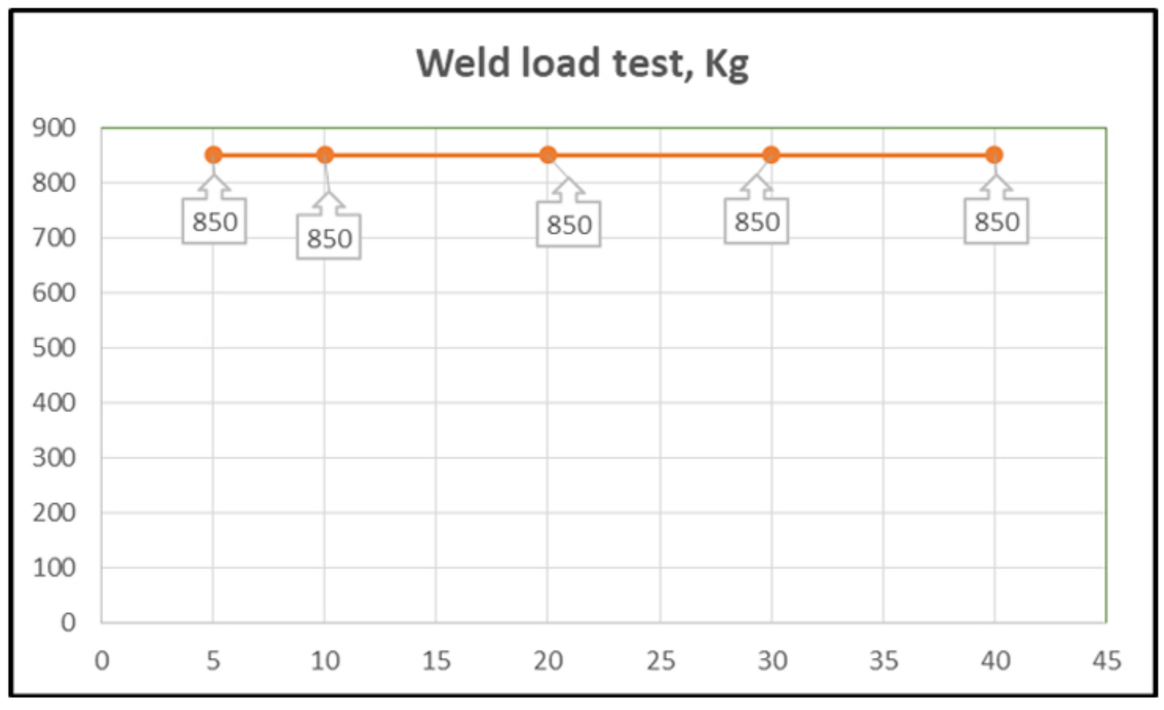




By increasing % ester content in oil the effect on wear scar diameter is shown in below graphical presentation.

Tribological testing results of Conventional Oil Vs. New generation Oil





KEY FEATURES ESTER BASED OIL

- Biodegradability & low toxicity
- High viscosity index
- Reduced friction & wear
- High temperature stability
- Low temperature flow ability
- Low volatility
- Good wetting characteristic
- Quick settling of chips & swarf
- Good rust protection
- Less oil carryover
- Good finish and achieving the tolerance
- Improved tool life
- Good Heat carrying capacity

CASE STUDY: 1

CUSTOMER

Company Based in Western India, which involved in the manufacturing and supply of range of Single Screw Barrel and Twin Screw Barrel.

TRIAL OBJECTIVE

1. Improve the tool life
2. Reduce the smoke and heat generation
3. Good wetting Nature
4. Less consumption

APPLICATION/OPERATING DETAILS

1. MachineHTT Make
2. Tank Capacity 5000 Ltrs
3. Component Screw Barrels
4. Tool Make Botek (Imported Tools) : BTA 3 guided pad
5. Average Length of Barrel 4500 mm
6. Dia of Barrel 30 mm ~250 mm
7. Material EN 41B (Alloy Steel)
8. Application BTA Drilling
9. Filtration Cartridge Type
10. Cycle time, min 30
11. Feed Rate 0.15 mm/sec
12. Insert Life
    1. Guide Pad: insert 20 meters (Avg Cost / insert: Rs 7500)
    2. Peripheral Insert : 12 meters (Avg Cost / insert: Rs 4000)
    3.Centre insert : 10 meters (Avg Cost / insert: Rs 4000)

MACHINE & COMPONENT VIEW

PRODUCT RECOMMENDED

HICUT N 22 HF

TRIAL RESULTS

Parameters	Guide pad insert life	Peripheral insert life	Centre insert life	Feed mm/s	Avg Cycle Time	Smoke	Job Temp
Competitor Product	20 mtrs	12 mtrs	10 mtrs	0.15	30 mins	Yes	Feels Hot
HICUT N 22 HF	**130 mtrs**	**18 mtrs**	10 mtrs	**0.25**	**20 mins**	**Very less**	**Warm**

Overall Results

1. Improved tool life > 50 %
2. Earlier tool cost was 1.5 Lakh/ month, has reduced to approx. Rs 50 K/month
3. Lesser smoke, safer to operators
4. Consumption reduced 20 %

Conclusion

1. The ester blended metalworking formulation
will give enhanced performance.

2. It is possible to use the formulated biodegradable
oils commercially, which will eliminate the problems of disposal.

3. Esters blended oils imparts good lubricity &
The stability of the oil is not affected by controlled temperatures.

4. Compare to mineral oil, ester blended fluids gives better
surface finish and improved tool life.

Selection of proper lubricant will give better results,
improvement in productivity & disposals properties.