Cylinder Oil

The large bore MAN B&W Model 12K80MC-S 2-stroke engines used by the Cabras 3&4 generation units are an example of large crosshead type engines. In large crosshead type engines, the cylinder is isolated from the crankcase and a separate cylinder lubrication system is fitted which supplies a measured quantity of oil to each liner.

The MAN B&W Model 12K80MC-S engine has 12 cylinders each with a cylinder liner. Each engine cylinder liner has eight lubricating points, where cylinder oil is injected into the liner via non-return valves from a mechanically driven piston pump lubricator. The injection of cylinder oil takes place during the engine piston upward stroke. Two-stroke engines fire-each revolution of the crank-shaft.

Cylinder liners require adequate lubrication in order to reduce piston ring friction and wear and to neutralize the sulfur in the residual fuel used by the plant. The oil film also acts as a gas seal between the liner and rings and as a corrosion inhibitor.

Practically all the injected cylinder oil is burned during the cylinder firing. The cylinder oil is thereby consumed as part of the combustion process that produces electric power. Therefore, cylinder oil has to be injected at an appropriate rate considering the amount of sulfur content in the fuel oil and the engine load.

Cylinder oil is a "use once consumable." It is injected into the cylinder at a feed rate to give optimum protection against acid corrosion and microsiezure (scuffing). Typical feed rates for a modern slow speed diesel engine are about 1.3 g/kWh. Note that the cylinder is the combustion chamber. Therefore, cylinder oil is meant to be burned as part of the combustion process in the production of electric power.

The oil used to lubricate the piston rings and liner must be thermally stable and be able to retain an oil film at the high surface temperatures found in the cylinder. The oil must possess anti wear characteristics, dispersants and detergents to ensure minimum deposits on the piston and the ring grooves. In addition, because of the high sulfur content in residual fuel oils, cylinder oil is high alkaline oil with a typical Total Base Number of 70 in order to prevent liner corrosion by sulfuric acid produced by the combustion process.

A specification for typical cylinder oil for an engine burning 3% sulfur fuel is shown below.

SAE Number	50
Specific Gravity kg/dm^3 (15°C)	0.942
Flash Point (°C)	241
Pour Point (°C)	-9
Viscosity cSt at 40 °C	247
Viscosity cSt at 100°C	21
Viscosity Index	100
Total Base Number (mg KOH/g)	70

The oil has a high TBN of 70 to neutralize the acids formed by the combustion of the sulfur in the fuel. These alkaline additives make up about 30% of the oil.

The viscosity of the oil is relatively high (21 cSt at 100 °C). This is so that it can lubricate effectively at the higher liner temperatures. The oil has a viscosity index of 100 which means it has a low tendency to change viscosity with temperature.

The heating values for both the high sulfur fuel oil and the cylinder oil are similar. Each quantity of cylinder oil combusted contributes almost the same amount of energy as the same quantity of high sulfur fuel burned by the plant.

Cylinder oils use dispersants for three reasons.

- They carry other additives in the base oil, mainly BN-additive.
- They carry dirt debris, which enters the lubricating oil and neutralized products.
- They prevent the dirt debris from sticking to the surfaces.

Generally, the higher the base number of the oil, the higher the dispersion.

The dispersancy of the oil is a delicate balance. Cylinder oil should have high dispersancy in order to keep the engine clean – especially in heavy fuel operation. If the dispersancy is too low, the dirt and asphaltenic contaminants will precipitate to form black sludge and carbon deposits.

Soot and coke create problems in diesel engines by reducing both combustion and heat transfer efficiency, and causing environmental pollution by stack solids and soot emissions. Dispersants keep soot and combustion products in suspension in the body of the oil charge and therefore prevent deposition as sludge or lacquer. These dispersants become depleted with time; one important reason for regular oil changes in heavily contaminated systems.

Cylinder oils have detergency properties. Detergents serve to hold the acid-neutralizing compounds in solution in the oil. They are usually alkaline and react with the strong acids (sulfuric and nitric) which form during the combustion of the fuel and which would cause corrosion to the engine internals if left unchecked. Neutral detergents are also used to impart anti-corrosion, anti-wear and even extreme pressure properties to oil.

Cylinder oil has several functions or effects:

- Reduces deposits and sludge formation
- Reduces lay-up time required for overhauls by cleaning the engine
- Reduces liner and ring wear. And provides excellent anti-scuffing control
- Provides superior piston and liner cleanliness to increase combustion efficiency and extend periods between piston overhauls
- Minimizes the corrosive effect of high sulfur fuel combustion
- Provides heating value that is directly used to produce electrical energy.

Cylinder Oil Features and Benefits (Mobil and Shell Products)

Cabras 3&4 and MEC 8&9 Slow Speed Diesel Power Plants use either Mobilgard 570 or Shell Alexia 50 cylinder oil products.

From Mobilgard 570 Brochure

Features	Advantages and Potential Benefits
Excellent thermal and oxidation stability	Reduced deposits and sludge formation
Extended oil life	Cleaner engine reduces lay-up time required for overhauls
Exceptional anti-wear properties	Reduced liner and ring wear. Excellent anti-scuffing control
Outstanding detergency capability	Superior piston and liner cleanliness increases combustion efficiency and extends periods between piston overhauls
High TBN Level and Retention	Wide fuel sulfur capability. Minimizes the corrosive effect of high sulfur fuel combustion
High Viscosity Index & Stable Base Stocks	Reduced cylinder oil consumption

From Shell Alexia 50 Brochure

Features/Benefits

- unique additive technology - contains outstanding neutralizing properties to counter corrosive acids resulting from the use of high sulfur fuels

- minimize deposit formation - on critical parts such as cylinder ports, pistons, piston rings, ring grooves and under piston spaces
- low cylinder and piston ring wear - cylinder wear rates below 0.05 mm per 1000 hours have been experienced
- excellent engine cleanliness - keeps engines clean – even under extended intervals
- storage stability - product has demonstrated excellent stability in storage under varying conditions
- sight-glass fluid compatibility - compatible with all normal lubricator sight glass fluids
- service experience - over 35 years in close co-operation with ship-owners