Engines for Fishing Boats

Criteria for Selection – II

M. VELU
Central Institute of
Fisheries Technology, Cochin-5

Method of Cooling

The most common methods of cooling of marine engines are by using (1) sea water (2) fresh water and (3) air.

Direct sea water cooling is the most logical method as there is an abundance of sea water available around the boat. The method is the least expensive as it requires only one pump for circulation of sea water and can be used with advantage, if the various component parts with which sea water comes in contact, are made of corrosion resisting material. Apart from possibility of corrosion, use of sea water will however cause excessive scale formation in the water passages of cylinder block and liners, cylinder heads, reduction gear housing etc.

Closed circuit freshwater cooling system was developed to minimise corrosion and scale formation. In this system only fresh water circulates within the engine, the heated fresh water being cooled by sea water through a heat exchanger, and as such there is no scale formation or corrosion. This system is more expensive due to the addition of one more pump for circulation of fresh water, the heat exchanger and considerable length of piping for connecting all these components. The chances of failure are also more, as this involves two pumps. Any leakage in the heat exchanger cannot normally be repaired and will result in sea water mixing up with fresh water and entering the cooling system within the engine.

Fresh water cooling using keel cooler (two or more pieces of long pipes connected together to form a long coil and fixed outside the boat) takes advantage of the availability of unlimited quantity of sea water around the boat. It is very simple and relatively cheap amongst the fresh water cooling system but is, however, suitable only for small engines. It is not advisable to adopt this system for larger boats as the keel cooling pipes are suceptible to be damaged by galvanic corrosion and by hitting against floating objects. It will be necessary to dry dock the boat for attending to any repair to the keel cooler.

Air cooled engines are quite light and possess slightly higher thermal efficiency. As there is no water circulation, corrosion is totally absent and the engine and engine room can be kept comparatively cleaner. The chances of breakdown are also reduced due to the absence of water circulation pumps. But this system requires huge quantity of air for engine cooling due to the low specific heat (heat carrying capacity) of air and provision must be made for circulation of sufficient quantity of air with ducting and trunking, which might occupy considerable deck space. Further, the usefulness of this method is limited to small engines around 100 HP in a tropical country like India.

Reduction Gear Ratio

As pointed out earlier the modern tendency is to go in for higher and higher speeds for engines, made possible by developments in metallurgy, design of combustion chamber, lubricants etc. But the efficiency of the propellor varies inversely with the speed of rotation within limits, which means a low propeller speed. This can be achieved only by using a suitable reduction gear. While selecting the engine, it should be ensured that the final speed at the propeller shaft is between 350-600 rpm so that the maximum size of propeller can be used resulting in better efficiency and higher thrust.

It will not be out of place here to clear a misconception generally prevalent that a higher reduction gear can substitute a higher HP engine. Nothing can be farther from truth. A higher reduction gear can only facilitate use of optimum size propeller thus improving the propeller efficiency, and nothing more.

Stern Gear

The propeller shaft (tail shaft), stern tube and propeller are collectively termed as 'stern gear'.

The stern tube should be of sufficient length to suit the particular boat in which it is to be installed and should have good quality stern bearings preferably of cutless rubber or Lignum vitae, an imported natural wood. White metal stern bearings are known to wear out fast causing considerable wear on the tail shaft as well. Indigenous timbers such as Red cutch, and Andaman bullet wood have also been found to be suitable for making stern bearings for small boats.

The tail shaft should be of bronze or 18/8 nonmagnetic or similar quality stainless steel. Mild steel, En steel etc. are known to be severely attacked by corrosion especially in wooden vessels.

The choice of propeller deserves much attention. Both solid and variable pitch (or controllable pitch) propellers are available particularly for imported engines. The advantages and disadvantages of variable pitch propellers are enumerated below:

Advantages

1. Reversible without a reversing gear.
2. Constant engine speed at any condition of loading facilitating running of the engine at most economical speed.
3. Maximum free running speed and maximum pull at trawling by adjusting pitch of the blade.
4. Rapid manoeuvrability.
5. Economy in fuel consumption.
6. Practical means of avoiding critical torsional vibration conditions.
7. Replacement of damaged blade easier and less expensive than replacement of whole propeller as is required in the case of solid propellers.

Disadvantages

1. Possibility of over-loading the engine as the pitch of the propeller is adjusted on the judgement of the skipper.
2. Higher initial cost.
3. Difficult to maintain and very vulnerable as the whole control mechanism of the ship is outside the boat, underwater.
4. Replacement of hollow shafts etc. is difficult as they are not readily available in the market.

Variable pitch propellers are not manufactured in India. In spite of certain advantages, particularly for trawlers, they cannot be recommended for larger boats due to maintenance problems as evidenced by past experience in this country.

Solid propellers should be designed for trawling duties with a blade area ratio (BAR) of 0.45 – 0.5. Pitch/Dia. (P/D) ratios between 0.6 – 0.8 will normally be able to avoid cavitation under trawling conditions. It should also be checked whether the boat in which the engine is to be installed can accommodate the optimum size propeller.

The material of the propeller should also be selected with care. Manganese bronze propellers, which are known to render satisfactory service in many parts of the world, are, under Indian conditions, found to be affected by dezincification—the zinc content of the bronze being corroded away leaving a highly brittle material. Gun metal propellers are found to work quite satisfactorily in most of the Indian ports.

Specific Fuel Consumption and Fuel Oil used

It is well known that almost 50% of the operating cost of a fishing boat is accounted for by expenditure on fuel. It is therefore necessary to carefully examine the fuel consumption of the engine not only from the pamphlets supplied by the engine manufacturers, which quite often make exaggerated claims, but from actual performance of the engines as well, wherever this is possible. An engine with a higher fuel consumption will be more expensive to operate, in the long run eventhough its initial cost may be low.

It was mentioned earlier that high speed engines can be run only on high speed diesel oil while medium and slow speed engines can work on lower grade fuels such as light diesel oil also. In our country due to prevailing tax structure it so happens that light diesel oil costs only about 50% of HSD. Use of light diesel oil instead of high speed diesel oil will result in substantial reduction of fuel cost, which will go a long way in balancing the slender economy of operation of a fishing boat, which is subjected to the vagaries of nature and is highly unpredictable.

More frequent overhauling and replacement of fuel injection equipment, piston rings etc. will however be required when LD oil is used but this will be more than off-set by the overall reduction in the cost of operation.

Cost of Engine and Spare Parts

Even though cost is an important factor to reckon with in the choice of an engine, it will be unwise to be guided by this alone. The costliest engine is not necessarily the best engine nor an inexpensive one inferior because it is cheaper. Besides other things, the cost of the engine is determined by the cost of raw material, labour and machining charges, overheads, total quantity of production, auxiliary equipment and fittings supplied along with the engine, after sales service and other services rendered by the manufacturer or selling agencies and so on. These will vary from manufacturer to manufacturer. It is necessary to make an objective assessment of the intrinsic value of the engine before making a choice taking all the relevant factors into consideration.

The largest single expenditure on maintenance of an engine is on spare parts. It is quite often noticed that the cost of spare parts are exhorbitantly high, which makes the operation of the engine costlier in the long run. It is particularly prone to happen when the engine manufacturer alone is producing the spare parts in which case, one is compelled to buy the spare parts only from them at their terms. The cost of different spare parts and how frequently they require replacement in the normal course should also be taken into consideration while deciding upon any particular engine.

The free availability of spare parts is also equally important. It is always advantageous to buy an engine for which spare parts are readily and locally available as this will minimize down-time and reduce expenditure on stocking of spares.

Additional Fittings and Safety Devices

Additional fittings other than those essentials required for normal running of the engine such as bilge pump, power-take-off arrangements, electrical generators and safety devices etc. add to the value of the engine. Some firms sell what is called a 'packaged engines' by supplying the entire hardware required for the installation of the engine including pipes, valves, foundation bolts, intermediate shafts etc. This minimises the burden on the part of the boat yard and ensures that good quality material is used for installation of the engine.

Starting System

The important methods of starting a marine diesel engine are:

a) Hand starting

b) Electric starting

c) Air starting

Hand starting is the simplest and most reliable device but its use is limited to small engines below about 50 H. P. Between electric and air starting, the latter, with recharging facilities either through a separate compressor or from the main engine, is preferable as air starting equipment is very reliable and easy to maintain. In almost fifty per cent of the boats fitted with electric starting arrangements, particularly the smaller ones, the starting system invariably fails as its delicate components cannot withstand the corrosive atmosphere prevalent inside the engine room. It is really unfortunate that none of the engines manufactured in this country are provided with air starting arrangements which are ideal under Indian conditions.

General Construction and Accessibility of Various Parts of the Engine

An engine with component parts generously dimensioned has a better chance of success than others. The accessibility of various parts has an important bearing in servicing and overhauling the engine. For example, there are certain engines which do not have side-doors on the crank-case for removing big-end bearings. The sump will have to be removed to reach the big-end bearings, which means that the engine should be lifted up even for top-overhauling.

Number of Cylinders

The number of cylinders in the engine also has an important bearing in the choice of the engine. More number of cylinders mean uniform running of the engine due to even distribution of power impulses and help balancing of the engine. But the requirement of certain important spare parts such as pistons, piston rings, valves, connecting rods, big end and main bearings fuel injectors etc. varies in direct proportion to the number of cylinders. It is therefore obvious that other things being equal an engine with less number of cylinders should always be preferred.

Vibration and Noise Level

Excessive vibration is bad for the engine as well as the boat. Even though no rigid formula can be prescribed defining the degree of permissible vibration it should be borne in mind that slow speed engines normally induce a higher degree of vibrations compared to high speed engines and as such care should be exercised to see that the hull is sufficiently strong to withstand the vibration, whenever a slow speed engine is selected. An engine with excessive vibration, if fitted in a weak hull will create problems of misalignment, leakage and opening up of the hull planks, besides making living on board the vessel uncomfortable.

A noisy engine will also make working and living on board uncomfortable. Further, there are regulations prohibiting plying of boats with excessive noise within port areas. It should be ensured that the engine is provided with suitable silencers to reduce noise to a tolerable level.

Conclusion

The foregoing gives only a general idea of the important points to be considered in selecting an engine. It is obvious that there is no simple yardstick to measure the true value of an engine as this is based on too many factors, which cannot be expressed in readily measurable quantities. Each one has to be critically evaluated, keeping in mind the specific requirements.

The real worth of an engine lies in its ability to give troublefree service and perform the duties expected of it, under given conditions with minimum of maintenance and this alone should be the cardinal guiding principle in the final selection of an engine.