13. Viscosity Index

The arbitrary scale which measures the variation of viscosity with temperature is called viscosity index. Generally the viscosity of an oil decreases with rise in temperature. The viscosity of a good lubricant should not change very much with the rise in temperature. If the viscosity of oil is very much affected with the rise in temperature it is called low viscosity index. Similarly if the viscosity of oil is slightly affected with the rise in temperature, it is called high viscosity index lubricant. A good lubricant should have high viscosity index. Such lubricants can therefore be used over widely varying temperatures and are known as 'all weather lubricants'.

Some lubricants having high viscosity Index are following :

Silicones, Polyglycol ethers, Diesters, Or triesters, etc.

Determination of viscosity index. For the determination of viscosity index of experimental oil the viscosities of testing oil at 100°F and 210°F are first found out. If the difference between the two values is low then the oil is good and if the difference is high then the oil is poor. The viscosity at 100°F of the oil under test is represented by U. Now we compare the viscosity of oil under test with two standard oil, one with the highest viscosity index (VI = 100) and another with the lowest viscosity index (VI = Zero). Paraffinic-base Pennysylvanian oils have highest viscosity index (VI = 100) and naphthanic base Gulf oils have lowest viscosity index (VI = Zero). Against each of these is marked their viscosities at 100°F and 210°F. The former are known as H-oils and the latter as L-oils. We get a series of these two types of oils.

Now from the list of H-oils (VI = 100) we choose the oil which has the same viscosity at 210°F as the oil under test and its corresponding viscosity at 100°F is noted. It is represented by H. Similarly from the list of L-oils (VI = zero) we choose the oil which has same viscosity at 210°F as the oil under test and its corresponding viscosity at 100°F is noted. It is represented by L.

Now, Viscosity Index (VI) may be calculated as

$$\text{Viscosity Index (VI)} = \frac{L - U}{L - H} \times 100$$

where U = Viscosity of experimental oil at 100°F

L = Viscosity of low viscosity index standard oil (Gulf oil having VI = Zero) at 100°F and also having the same viscosity of experimental oil at 210°F

H = Viscosity of high viscosity index standard oil (Pennysylvanian oil having VI = 100) at 100°F and also having the same viscosity of experimental oil at 210°F.

Viscosity index of lubricating oil may be increased by adding of certain organic polymers, which are partially soluble in the oil. The produce oil-polymer blends, which have a very slight temperature coefficient of viscosity.

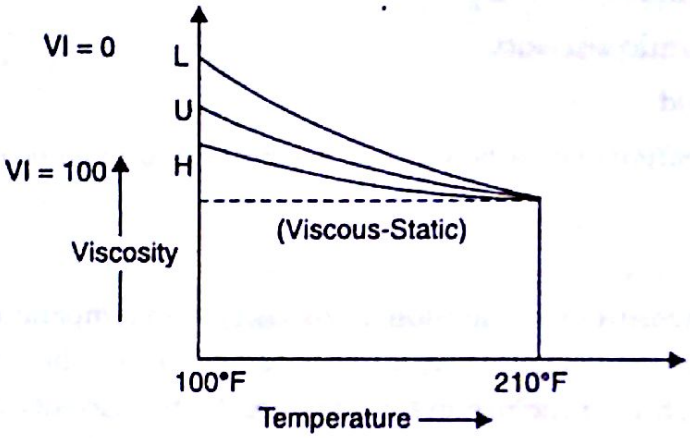

FIGURE 6.11

The effect of temperature on viscosity may be represented as in Fig. 6.11. The viscosity-temperature curves of the experimental oil along with two standard oils having high and low VI are represented in Fig. 6.11. Lubricating oils with small variation in viscosity along with temperature exhibit flatter curve as in case of high viscosity index oil. Linear molecules of the lubricant having flexibility through free rotation about the chemical bonds shows generally a high viscosity index. Hence we prefer a high viscosity index lubricant in practice due to the same viscosity over a range of temperature. The state of a lubricant when its viscosity does not change with rise in temperature is called Viscous-Static. Such type of a lubricant can be prepared by adding appropriate amount of a suitable linear polymer or viscosity-index improver.

Numerical. *An oil of unknown viscosity index has a Saybolt universal viscosity of 58 seconds at 210°F and of 580 seconds at 100°F. The high VI standard (Pennysylvanian oil) has Saybolt viscosity of 58 seconds at 210°F and 430 seconds at 100°F. The low VI standard (Gulf oil) has a Saybolt universal viscosity of 58 seconds at 210°F and 780 seconds at 100°F. Calculate the VI of unknown oil.*

Solution.

Here L = 780 sec, U = 580 sec and H = 430 sec

$$\text{VI of experimental oil} = \frac{L - U}{L - H} \times 100 = \frac{780 - 580}{780 - 430} \times 100 = 57.14$$