Hydraulics

Introduction

Hydraulics is a branch of science concerned with the practical applications of fluids, primarily liquids in motion. It is related to fluid mechanics, which in large part provides its theoretical foundation. The basic idea behind any hydraulic system is very simple: - you cannot compress a liquid. The force or pressure that is applied at one point in a sealed system is transmitted to another point. The force is almost always multiplied in the process.

Fluid systems involve the use of fluids to transmit and multiply force. When the fluid is a liquid, the system is called a hydraulic system. When the fluid is gaseous, the system is called a pneumatic system. Hydraulic fluids such as hydraulic oil are incompressible whereas pneumatic fluids such as air are compressible.

Understanding hydraulics is very complicated, but a basic understanding of the principle of how it works is actually very straightforward. Hydraulics deals with such matters as the

flow of liquids in pipes, rivers, and channels and their confinement by dams and tanks. The scope of this course however extends to mechanical systems and devices as actuators and control systems that power today's industrial machinery.

The hydraulic systems work on a simple principle that you cannot compress a liquid, and a force that is applied at one point is transmitted to another point by that incompressible fluid. Because of its liquid nature, hydraulic systems can transmit force through pipes of any shape and length, so the force can be applied at one central point and transmitted efficiently to another point or to multiple points far away.

Most hydraulic systems consist of a pump, hoses and lines, cylinders and motors, valves, a cooling unit, a reservoir, filters and hydraulic fluid (oil). At the heart of the system is the pump which circulates the same fluid repeatedly from a fixed reservoir that is part of the prime mover. The fluid is an almost non-compressible liquid, so the actuators it drives can be controlled to very accurate positions, speeds, or forces. Most hydraulic systems use mineral oil for the operating media but other fluids such as ethylene glycol, or synthetic

types are also used. Some advantages of hydraulic systems are: greatly reduced noise levels at the machine, the availability of backup pumps to take over if a working pump fails; less total horsepower and flow, and increased uptime of all machines. Another advantage hydraulic-powered machine is that they can operate at higher pressure -- typically 1500 to 2500 psi. Higher pressures generate high force from smaller actuators.

The extensive use of hydraulics to transmit power is due to the fact that a properly constructed hydraulic system possesses a number of favourable characteristics. These are as follows: Eliminates the need for complicated systems using gears, cams, and levers. Motion can be transmitted without the slack inherent in the use of solid machine parts. The fluids used are not subject to breakage as are mechanical parts. Hydraulic system mechanisms are not subjected to great wear.

The main disadvantage of hydraulics is increased first cost because a power unit is part of the machine. If the machine life is longer than two years, the higher initial cost is often offset by lower operating cost due to the much higher efficiency of hydraulics. Another problem area in hydraulics

is housekeeping. Leaks caused by poor plumbing practices and lack of pipe supports can be profuse. This can be exaggerated by overheated low-viscosity fluid that results from poor circuit design. With proper plumbing procedures, correct materials, and preventive maintenance, hydraulic leaks can be virtually eliminated. In general, hydraulic systems are usually more complex and require skilled personnel to handle hydraulic problems.

Learning Objective:

- Where are hydraulics used;
- Learn the hydraulic principles - calculation of required pressure, required flow and required power;
- Understand hydraulic system, hydraulic systems found on today's modern equipment;
- Analyze hydraulic flows.
- Explain the operation and applications cylinders, pumps and motors;
- Understand the working turbines and pumps, understand pump characteristics.

- Describe, how various hydraulic components operate and work together in a system;
- Utilize continuity equation, buoyant force etc;