

## ANALYSIS OF FLUIDS FOR HYDRAULIC LIFTS

Sumeet Sambhaji Pisal<sup>1</sup>, Shantanu Prabhu Mosalakanti<sup>2</sup>

<sup>1,2</sup>Student, Department of Mechanical, Vishwakarma Institute of Technology, Maharashtra, India

\*\*\*

**Abstract** - A hydraulic lift is a type of machine that uses a hydraulic apparatus to lift or move objects using the force created when pressure is exerted on liquid in a piston. Force then produces "lift" and "work." Working of hydraulic lift is based on Pascal's Law. A multiplication of force can be achieved by the application of fluid pressure according to Pascal's principle. This allows the lifting of heavy loads with a small force, as in auto hydraulic lift. The report comprises of the variations of load to be lifted by taking various fluids (water, milk, honey, oil).

**Key Words:** Hydraulic lift, Pascal's Law, Hydraulic Fluids

### 1. INTRODUCTION

A hydraulic lift is a type of machine that uses a hydraulic apparatus to lift or move objects using the force created when pressure is exerted on liquid in a piston. Force then produces "lift" and "work." The controlled movement of parts or a controlled application of force is a common requirement in the industries. These operations are performed mainly by using electrical machines or diesel, petrol and steam engines as a prime mover. These prime movers can provide various movements to the objects by using some mechanical attachments like screw jack, lever, rack and pinions etc. However, these are not the only prime movers. The enclosed fluids (liquids and gases) can also be used as prime movers to provide controlled motion and force to the objects or substances. The specially designed enclosed fluid systems can provide both linear as well as rotary motion. The high magnitude-controlled force can also be applied by using these systems. This kind of enclosed fluid-based systems using pressurized incompressible liquids as transmission media are called as hydraulic systems.

### 2. PRINCIPLE

**Pascal's Law:** According to this principle, the external static pressure applied on a confined liquid is distributed or transmitted evenly throughout the liquid in all directions. The static pressure acts at right angles to any surface in contact with the fluid. Pascal also found that the pressure at a point for a static fluid would be same across all planes passing through that point in that fluid.

Pascal's Law formula,  $F=PA$

Where,

A- Cross Sectional Area

F- Force applied

P- Pressure transmitted

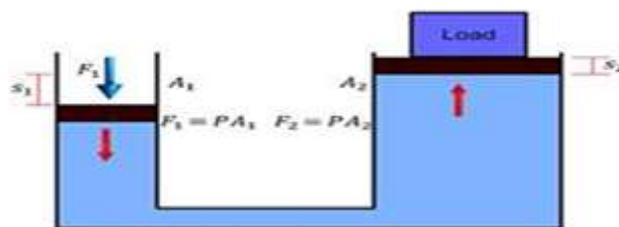


Figure 1

This allows the lifting of a heavy load with a small force, as in an auto hydraulic lift, but of course there can be no multiplication of work, so in an ideal case with no frictional loss:

$$W_{input} = W_{output}$$

### 3. CONSTRUCTION

Components of direct acting hydraulic lift:

- Fixed cylinder: It is fixed with the wall of the floor, where the sliding ram reciprocate when we apply the pressure.
- Cage: It is fitted on the top of the sliding ram where the load is placed (i.e. lifted load).
- Sliding ram: It is fitted in the fixed cylinder which is reciprocate (upward or downward direction) when we applied the pressure (i.e. reaches the floor wise.)

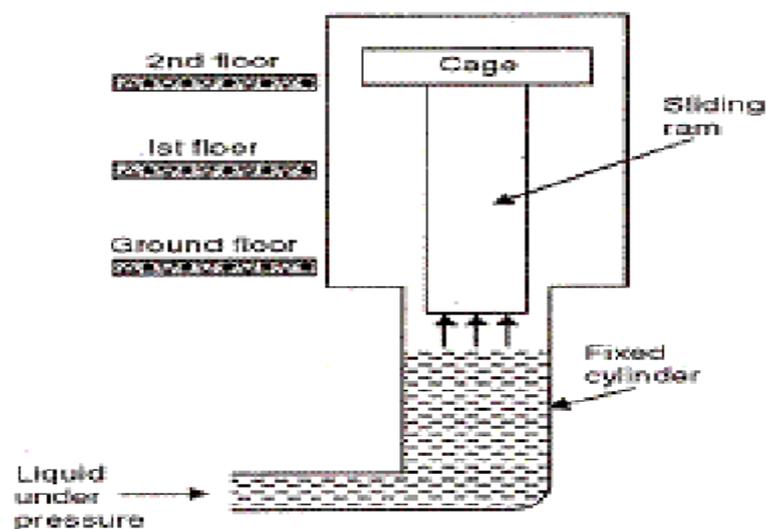


Figure 2

### 4. WORKING

- When fluid under pressure is forced into the cylinder, the ram gets a push upward. The platform carries loads or passengers and moves between the guides. At required height, it can be made to stay in level with each floor so that the goods or passengers can be transferred.
- In direct acting hydraulic lift, stroke of the ram is equal to the lift of the cage.
- Hydraulic systems use liquid to create pressure. Liquid particles are close together, meaning a liquid is almost incompressible. When the particles move, they strike each other and also bump against the walls of the container. Because the pressure in a liquid transfer in equal measure in every direction, a force applied at one point on a liquid transfer to other points on the liquid. You work out the pressure using the equation  $F \div (P \times A)$ , where P is the pressure in Pascal, F is the force in newton and A is the cross-sectional area in meters squared. This is known as Pascal's law.
- In hydraulic systems, a small force across a small cross-sectional area transmits pressure and creates a large force over a larger cross-sectional area. Essentially, if you connect two cylinders, a large and a small one, and apply force to one cylinder, it generates equal pressure in both cylinders. Because one cylinder contains a larger volume, the force the larger cylinder produces is higher, although the pressure in the two cylinders remains the same.

### 5. HYDRAULIC FLUIDS

Although the original fluid used with the traditional cast iron component hydraulic systems was water, it was soon found to have some major flaws. For one, as soon as the temperature dropped, it would freeze. If the climate conditions were too hot,

it would then evaporate. Although water is still used in certain situations and applications, it will usually be emulsified with oil.

These days, the most typical hydraulic fluids are those made from refining mineral oil. In some cases, it's necessary to make them fire resistant and in these cases, they are likely to be manufactured from a variety of different materials blended together.

The advantage of using mineral oil is that it can generally handle extreme temperatures. However, these fluids can also suffer from having a low flash point, sometimes between only 150° to 250°C. When there is a fire risk present, fire resistant fluids are typically used. Although water is a suitable addition where there is a risk of fire, it has some quite obvious issues. By adding 10% emulsified oil to water, it's possible to gain the required lubrication. Mixing 40% water with oil and special agents will produce a fluid that is fire resistant. A flash point as great as 600°C is possible from using synthetic fire-resistant fluids. However, these types of fluids can be very expensive.

The three main categories of Hydraulic fluids are:

- Petroleum based fluids.
- Water/Oil based fluids.
- Synthetic based fluids.

## 6. APPLICATIONS

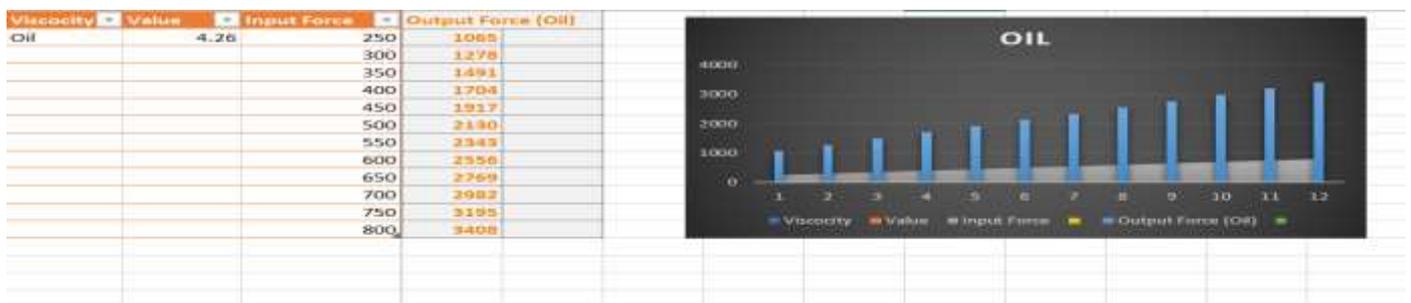
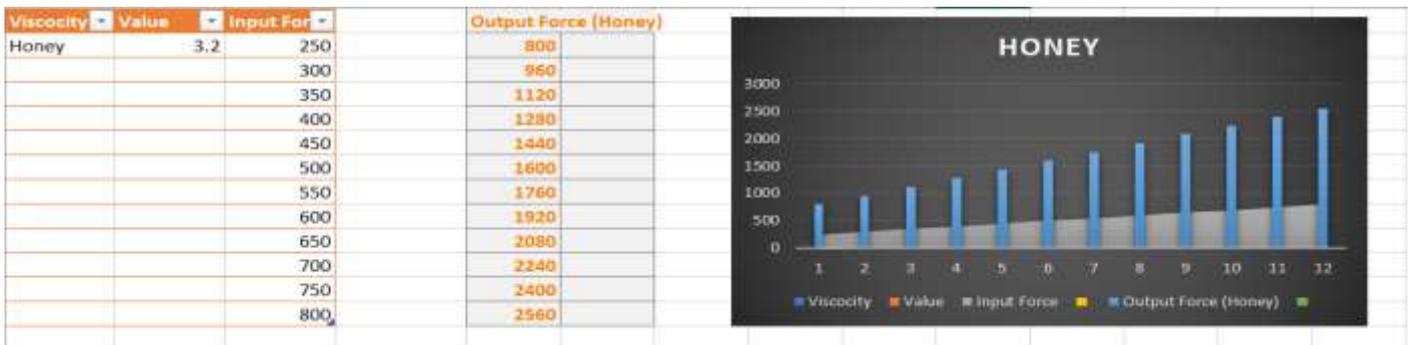
Hydraulic lifts are used in an extensive assortment of automotive, shipping and waste removal applications. They are an effective means of raising and lowering people, equipment, cargo and machines, and find regular use in automobile repair. A vast number of trucks utilize hydraulic lifts to facilitate the transport of heavy freight, and hydraulic lifts provide an excellent solution to certain nursing and disability concerns. Hydraulic lifts can serve as work platforms for employees, heavy equipment movers and loading areas. Different types of hydraulic lift systems are available, including scissor lifts, two-post lifts, four-post lifts, carousel lifts and mezzanine lifts. All hydraulic lifts use hydraulic pressure as the motive force. In many cases, hydraulic lifts are powered by air compressors. These air compressors pressurize the hydraulic oil, allowing it to lift the associated load. If the air compressor has not had sufficient time to pressurize the hydraulic fluid, the lift will not function. Other hydraulic lifts use an electric motor driven pump or a fuel motor driven pump to pressurize the fluid.

## 7. ADVANTAGES

- The hydraulic system uses incompressible fluid which results in higher efficiency.
- It delivers consistent power output which is difficult in pneumatic or mechanical drive systems.
- Hydraulic systems employ high density incompressible fluid. Possibility of leakage is less in hydraulic system as compared to that in pneumatic system. The maintenance cost is less.
- These systems perform well in hot environment conditions.
- Hydraulic lifts are often durable and made to last. They can lift and position very heavy machinery, equipment and other weighty objects in warehouses, construction projects, factories, remodeling projects, major reconstruction, and more.
- When loading and unloading trucks, hydraulic dock lifts can be quite helpful in aiding the process. It will lessen the timeframe it takes to load the truck by hand. It also helps lessen the number of employees it will take to load and unload.
- Scissor lifts are often used to move employees from one work station to the next. The way the lifts maneuver is convenient for many situations where employees must reach hard to access areas without such a device. Electricians and other similar industry workers use hydraulic lifts in their line of work to help them access hard to reach places.

- Overall, hydraulic lift tables make it easier for factories and warehouses to work efficiently. They lessen the time it takes to do a job, while making the work environment safer. Ladders and other nuisances that can cause for clutter can be avoided.

### 8. CALCULATIONS



## 9. CONCLUSIONS

The major function of a hydraulic fluid is to provide energy transmission through the system which enables work and motion to be accomplished.

Hydraulic fluids are also responsible for lubrication and heat transfer.

Also, Hydraulic lifts depend on the viscosity of the fluid to be used.

The fluid satisfying the above criteria's is considered to be the best as the hydraulic fluid.

## REFERENCES

[1] FLUID MECHANICS TEXTBOOK- S PATI

[2] <http://sciencing.com>

[3] <http://en.m.wikipedia.org>

[4] John L Croll; Hydraulic Lift ;17 May 1956; US2937003A

## BIOGRAPHIES



Sumeet Sambhaji Pisal, Student at Mechanical Engineering Department, Vishwakarma Institute of Technology, Pune.



Shantanu Prabhu Mosalakanti, Student at Mechanical Engineering Department, Vishwakarma Institute of Technology, Pune.