ISSN: 2321-8169
126– 128

Lifting Objects using Buoyancy

Mr. Ravindra R. Paliwal [1]
Department of Mechanical Engg.
Anjuman College of Engineering & Technology, Nagpur
ravi_paliwal200731@rediffmail.com [1]

Mr. Huzaifa Fidvi[3]
Department of Mechanical Engg.
Anjuman College of Engineering & Technology, Nagpur
huzaifafidvi@hotmail.com[3]

Mr. Abhyuday Paliwal [2]
B.Tech., Mining Engg., IIT (BHU), Varanasi (UP)
abhyuday.paliwal.min13@iitbhu.ac.in[2]

Ms. Namrata Lotia[4]
Department of Mechanical Engg.
Anjuman College of Engineering & Technology, Nagpur
n_lotia@yahoo.com[4]

Abstract: The conventional methods which employ machinery to lift objects or goods require high amount of energy to accomplish the job. Owing to the conventional mechanical losses which cannot be averted, the amount of energy required is considerably higher than the amount required to overcome the potential energy of the system. This paper intends to propose a new method of lifting objects in which unnecessary expenditure of energy could be possibly averted.
Keywords: *Buoyancy, Viscosity, Drag, Laminar flow, Turbulent flow.*

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I INTRODUCTION:

When an object is immersed in a liquid such that it doesn't touches the bottom surface or the floor over which the liquid is contained, it experiences an upward force having a magnitude equal to the weight of the liquid displaced. The idea is to employ this nature's law to lift objects by supplying as minimum energy as possible in the whole process. A model that works on the above concept has been proposed in this paper.

II MAIN CONTENT

Water applies an upward force (opposite to the direction of gravity) to objects when submerged under it. When this force (buoyancy) is dominant against other forces acting opposite in direction to it, such as the weight of the object and the liquid drag, the object starts to move up vertically when released from the submerged state. This paper intends to exploit this property of liquid, to lift objects to the required heights without requiring energy to be spent on "lifting" specifically, however some energy would be required to place the objects at right places where they could experience this phenomenon.

The proposed method could possibly consume less energy than the conventional methods by working in this fashion.

1. **Buoyancy**: Buoyancy is an upward force exerted by a fluid on a body immersed it, having a magnitude equal to the weight of liquid displaced by the body. [1]

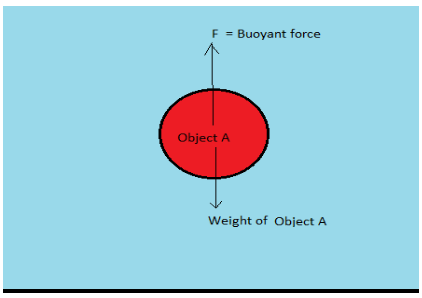

Figure 1: Buoyancy acting on a submerged object.

2. **Viscosity**: Viscosity of a fluid is a measure of its resistance to gradual deformation by shear stress or tensile stress. For liquids, it corresponds to the informal concept of "thickness". [2]
3. **Drag**: In fluid dynamics, drag refers to forces acting opposite to the relative motion of any object moving with respect to a surrounding fluid. This can exist between two fluid layers or a fluid and a solid surface. The drag force is proportional to the velocity in case of laminar flow and square of velocity in case of turbulent flow. Laminar drag is dependent on viscosity whereas turbulent drag is independent of viscosity. [3]

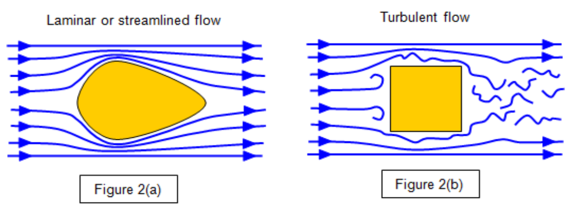

Figure 2: laminar (a) and turbulent flow (b)
(Courtesy of -http://www.schoolphysics.co.uk/)

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III Model of lifting

Take a hollow object or container such that it is strong, light in weight and could float on water. Let's call it "Vessel". Vessel should preferably be spherical in shape so that objects or goods to be lifted up could fit inside it well and up to a significant quantity. Make a liquid proof gate on the surface of Vessel so that objects could be put in and removed out. Let's say Vessel density is c_1 and radius is r_1. Determine appropriate value of r_1 and ρ_1 so that Vessel could comfortably lift a specific quantity of objects having certain size and mass. Then depending on the rate at which objects are to be lifted upwards, suitable no. of Vessels required to do the job should be determined.

Take a hollow cylinder closed at the bottom and opened at top, preferably of metal having height equal to the target height of lifting and radius around 1.5 times the radius of Vessel and completely fill it with liquid. Make a gate of appropriate size on the lower portion of the cylinder's wall, to put the Vessels at the inside-bottom of the cylinder. The gate should be designed considering aspects of liquid proofing and safety. Choose a suitable value of liquid's density considering the buoyant force and drag it would apply on Vessel and the pressure that it would apply on the cylinder's bottom gate.

A mechanical system would be required to put Vessel inside the cylinder via gate offering no or minimum drainage of liquid in the operation. The mechanical system should be strong enough to bear any hazard occurring due to failure of the bottom part of the cylinder or the gate, by refraining water to come out of it. The system should be made mechanically efficient so that it requires minimum power for its operation, thereby catering the main idea of the objective.

Depending on the size and mass of Vessel, it could be decided, whether or not to install a receiving mechanical system to fetch the Vessels out of the cylinder. Once the Vessels are fetched out from the cylinder, the contained objects or goods can be extracted from it. After extraction of goods, Vessels need to be brought down to use them again.

The liquid drained from the mechanical system (the one at the bottom of the cylinder) needs to be recycled into the cylinder to compensate the lost liquid thereby maintaining its constant height in the cylinder. However if the amount of liquid getting drained is less, recycling could be avoided and a tap as a source of liquid could be used to compensate the lost liquid.

Thus Vessels would transport their contents up and then they would be brought down to transport again. These continuous movements of Vessels up and down would thus do the job of lifting.

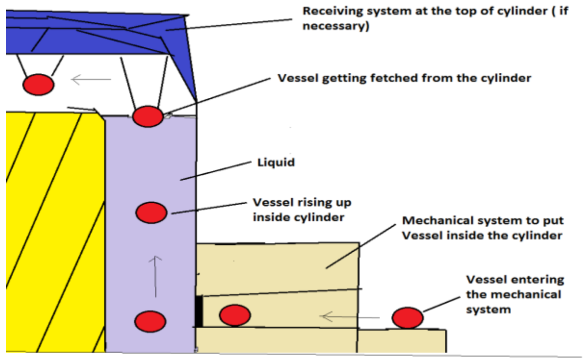

Figure3: The model: lifting of vessel by buoyancy

IV Limitations of this Method

1. This method has constraints for object's shape and mass i.e. not very heavy or big sized objects could be lifted using this method. This is an ideal method for medium or small sized objects. Example - This method could be efficiently exploited at construction sites to lift bricks and other items.

2. This method is appropriate to accomplish tasks where goods are required to be lifted to fixed heights rather than variable heights as the latter would be highly inconvenient.

V CONCLUSIONS AND SUGGESTIONS

This paper introduces to a new method of lifting that exploits buoyant force to lift objects.

The method claims to consume lesser power than conventional methods, however it is challenged by few limitations.

The Mechanical system that seals the junction of cylinder's bottom wall and its liquid proof gate is the most important component of the entire lifting system and therefore needs to be cleverly engineered.

The design of the cylinder, Mechanism of operation of the liquid proof gates, and smart mechanism of discharging Vessels into the cylinder via gate could allow us to extensively minimize the drainage of liquid. Doing so would not only save the unnecessary recycling of liquid, but also make the device more efficient.

The top of the cylinder should be cleverly engineered to make the fetching of Vessels from the cylinder easier.

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Lifting system could be optimized for better "mass of objects loaded in the Vessel - power required in lifting one vessel" ratio and desired lifting speeds by configuring liquid's density, mass of objects to be loaded in the Vessel, density of Vessel with appropriate values such that the desired objective is achieved.

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