INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

*(Volume3, Issue2)*

# Modification of Screw Pump by Using Intelligent Pump for Lifting Viscous Molasses in Sugar House Distillation Section

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***Abstract: In the present work, it is proposed that the tremendous growth has continuously risen in demand for power. So energy conservation and its utilization play an important role in now a day's Currently in sugarcane industry screw pump is used, which has some limitation is as follow:***

***1. The electrical motor is required to run the screw pump.***
***2. High maintenance cost***
***3. More consumption of electricity.***
***4. Low capacity of lifting high viscous molasses.***
***5. High initial cost.***

***So it is necessary to adopt energy conserving industrial pump overcome the limitation of screw pump by different alternatives, some of them are; centrifugal pump, rotary pump, pneumatic pump. Amongst, pneumatic pump (Intelligent pump) is more convenient and efficient than the other pump. Its performance is very closer to the required application.***

***Keywords: Pneumatic Pump, High Viscous Fluid, Electrical Motor, PLC.***

## 1. INTRODUCTION

In today's world industry are tremendously increasing and these industries are trying to find out advanced, automated and efficient machinery. The aim of this project is to investigate the use of pneumatic pump over the screw pump for lifting high viscous molasses in sugar house distillation section. This study will aim to design and develop pneumatic pump with various capacities of syrup, molasses, and juice of viscous liquid by using the highly pressurized pneumatic system. Also to achieve cleanliness and noiseless operation.

## 2. LITERATURE REVIEW / RELEVANCE:

Muhammed R. A., (2002) had found the alternative to Screw pumps which available from a long time in the lifting of viscous fluids application. The earliest version is the famous Archimedes' we'll still in use for raising water. Historically, the domain of twin screw pump applications was highly viscous liquids. Since the early 1990s, pump users realized they can be used successfully for multiphase pumping and less viscous liquids. This was particularly attractive for the oil and gas industry, where both viscosity and gas volume fraction (GVF) of an oil field can vary widely over its life. More- over, this extension of the screw pumps' domain of application coincided with an increased interest in off-shore production where the versatility of multiphase pumps is especially evident.

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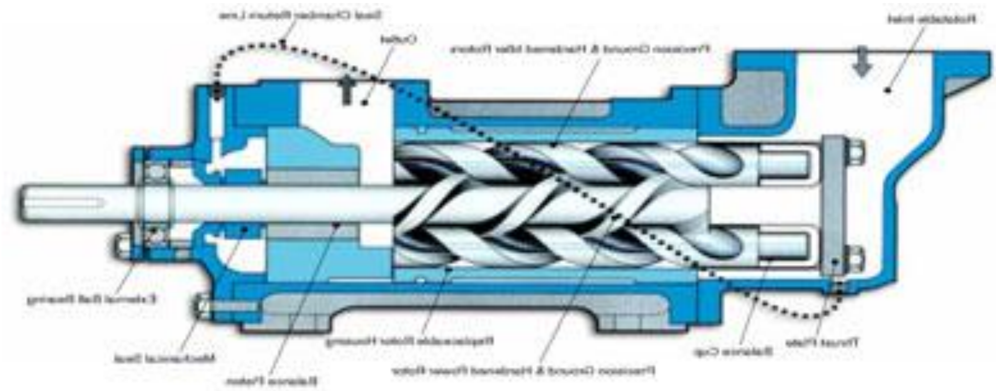

**Fig 2.1 schematic of screw pump (6, 7**http://www.google.com/)

Pumps that accommodate high GVF can be placed on the seabed near the well head to raise the pressure of the mixture of crude oil, water, and gas for direct transport to a Central platform for processing.
Shippen and Scott., (2008) discussed the benefit of screw pump as shown in fig. 4.1 were arrangement is compared to having a satellite platform to handle the two phases separately before delivery to the central platform.

Lawniczak et al., (1999) was investigated the performance of a short airlift pumping system operating at low submergence ratios. They studied the influence of riser tube diameter and injector design on the efficiency characteristics of the airlift pump. The air-injection system was designed such that the position of a cylindrical injector in a conical entrance section of the riser tube could be changed. Changing the injector position was shown to cause a corresponding change in the injector geometry parameter (ratio of water cross sectional area available at the air injection level to air injector cross-sectional area). They found that the effect of air injector position, in the conical entrance of the riser tube, depends upon the riser tube diameter. For each riser diameter, this effect was mainly restricted to the small values of the injector geometry parameter, while for higher values of this parameter, the efficiency curves differ slightly.

S. R. Vinaykumar., (2005) proposed the twin screw type of pump has multiphase capabilities.

Vetter and Wincek., (1993) developed a steady state model for two-phase flow. They simplified the action of the pump by modeling it as a series of disks moving continuously from suction to discharge. The disks represent the pump's chamber.

Mansour and Khalil.,(1990) presented effects of the air-injection method on the airlift pump performance were experimentally investigated by In their experimental study, they tested different injection designs under similar operating conditions. Experiments were carried out for different values of lift ratio and under different values of injection pressures. They concluded that the initial bubble size and distribution in the riser tube could have great effects on the pump performance.

Dara W., (2001) had found that Two- phase operations to serve the pump design process with basic assumptions of model are as follows;
(1) Fully developed steady state flow.
(2) All clearances connecting the chambers are filled with liquid phase only due to the centrifugal effects of the screw rotation. Their experiments confirmed the validity of the assumption for a GVF up to 80%.
(3) Ideal gas and isothermal compression, due to the higher heat capacity of the liquid phase.
Their model performance predictions agreed with their tests adequately. They reported measured and calculated screw rotor static deflection resulting from unbalanced hydraulic pressure and included the effect of clearance eccentricity due to rotor deflection.

**Fig 2.2 Image of screw pump (6, 7)**

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On the pressure and flow calculations. Their tests also concluded that 80% of the leakage goes through the circumferential clearance, while only 20% goes through the more geometrically complex radial and flank clearances.

Prang and Cooper., (2002) had reported empirical observation to simplify their steady state model. They treated the circumferential clearance as a short seal and used a Moody friction coefficient. Their model was simpler than Vetter's but agreed satisfactorily with their test results. Vetter et al. published additional test results in Ref. and compared them against results of the model in Ref. The test data included dynamic pressure measurements of sensors distributed axially along the screw length. These measurements will be used to validate the model presented in this study.

However, this screw pump requires more power to drive the system because of electrical 3 phase induction motor is used. Energy lost is more and also maintenance cost leads to loss of profit the plant (sugar cane factory). So to overcome the arising with screw pump can solve by a pneumatic pump. Here the electrical motor is totally eliminated so it definitely saves the cost of required motor. Also, the pneumatic pump performs the clean and noiseless operation in the sugarcane factory. In the advance day, we need to implement the of our process flow which can't be done with the screw pump this can do with the pneumatic pump by using PLC unit.

## 3. PROPOSED EXPERIMENTAL SETUP & EXPERIMENTAL PROCEDURE:

### 3.1 Schematic Diagram

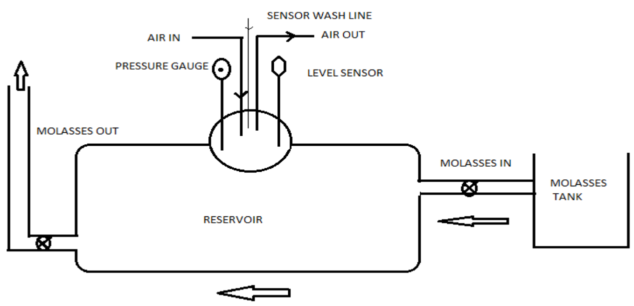


**Fig.3.1: Intelligent Pump Setup (AutoCAD)**

### 3.2 Construction

1. The intelligent pump is simple in construction; the molasses inlet is connected to the reservoir
2. The reservoir is connected to many junctions like molasses tank, delivery side & flange connection.
3. In flange connection, many junctions are connected like air in, air out, level sensor, pressure gauge and wash line.
4. The level sensor is used to sense the level of molasses in the tank.
5. Pressure gauge shows the pressure developed in the tank.
6. Molasses tank is used to store the molasses.

### 3.3 Working principle

The line diagram of designed pneumatic pump is shown in above fig. this consists Mainly the Molasses tank, pressure gauge, level sensor, hose. The working of the pneumatic pump is to be done as follows:
1. The high viscous molasses is collected in the molasses tank. From the molasses tank, the molasses is passed into the reservoir by opening inlet valve and closing the delivery valve.
2. At the time of operation, the air is passed into the reservoir. The level of incoming molasses is set in the tank. When the molasses reach to setup point of the tank which sensed by level sensor it creates the vacuum and lifting of molasses are done by a closing inlet valve and opening delivery valve.
3. When the one cycle is completed both inlet and delivery valve are closed, air is exhausted to atmosphere.
4. After that the steam is passed into the reservoir for cleaning the tank, to prevent its corrosion.
5. Finally, all the valves are closed and the cycle is repeated.
6. The intelligent pump is more advantageous over screw pump is that it avoids unnecessary work of pumping. This pump will act according to a load of lifting molasses and leads to conserving the energy. Also, maintenance cost is low and operates with less noise.

## 4. EXPECTED OUTCOMES

From the intelligent pump after successfully installed to expect the results:
1. The pump should operate with less power to conserve the energy.
2. It should lift high viscous molasses according to load on sugar house distillation section.
3. The intelligent pump should avoid unnecessary running, unlike screw pump when there is no load.
4. It should operate with low maintenance, less noise & high efficiency.
5. It should occupy less space.

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