Design and Fabrication of Sand Separator System in Bagasse Plant

¹,²,³,⁴,⁵Department of Mechanical Engineering
M.Kumarasamy College of Engineering, Tamilnadu, India

Abstract—An apparatus for separating natural gas from production streams comprising a liquid dispersion of water, sand, and natural gas is provided for. The separator comprises a vessel having an interior surface defining a spherical interior space. The interior space allows a production stream introduced therein to experience a velocity drop sufficient to allow separation of the natural gas from the sand and water components. The separator also comprises a stream inlet port in the vessel, a liquid drain in the lower end of the vessel, and a gas outlet port at the upper end of the vessel remote from the stream inlet port. A baffle is mounted in the interior of the vessel in the path of the production stream between the stream inlet port and the gas outlet port. The baffle is effective to spread and direct a high pressure production stream introduced into the interior space via the stream inlet port downward toward the liquid drain. Operational experience from many fields suggests that sand is produced along with oil and gas from the reservoir that have a relatively lower formation strength. The presence of sand impacts several design and operational aspect of the production system due to the potential of erosion, corrosion and accumulation of sand in pipelines and separators. The paper reviews erosion prediction and sand accumulation models. The paper will also address issues associated with sand removal and inhibitor performance and effectiveness when sand accumulation occurs.

Key words: Sand separators, feeder, Dressing tank Can box, Feed pipe flange

I. INTRODUCTION

In the competitive environment, we have to associate ourselves with higher productivity at a very low cost with the best quality goods. To survive in this world of warring business companies, the business professionals and engineers have turned their heads not only towards implementing hi-tech method but also to reduce the excess manpower and risk involved in manual handling which ultimately have let them towards better production.

TNPL is producing newsprint and fine papers in reel form. It uses bagasse as principal raw material in order to conserve forest resources for ecological balance in the country. Success of each industry depends not only on the initial investment of the plant equipments, but also depends on the maintenance cost. One such problem that a company faces is the periodic maintenance of ’Plug Screw feeder’ in Bagasse based Pulp mill.

Currently the plug screw which is the vital part in bagasse pulping in continuous digester is subjected to wear due to continuous movement of braise bagasse over it. The hope our project is to enhance the life of plug screw to facilitate paper production rate high.

The project deals with the feasibility study of selection of materials, up gradation and optimization of plug screw feeder system. The problem in existing plug screw feeder system is wear and tear of the plug screw, throat etc, and overloading of the screw feeder motor.

The objective of our project is to increase the performance of plug screw to reduce cost and down-time which in turn high production rate to the company.

II. ANALYSIS OF SAND SEPARATOR

![Fig. 1:](image-url)
A sand separator is a device that separates sand or other solids from water. One version of sand separator utilizes centrifugal force to separate sand or other heavy particles out of the water. The separated material drops down into a tank or reservoir where it can be removed later or in the case of in-well separators, the separated sand drops into the bottom of the well. It is not a true filter, since there is no physical barrier to separate out the particles, but it is often used upstream of a filter to first remove the bulk of the contaminant, where the filter does the final cleaning. This type of design reduces the time required to flush and clean the filter.

A. Types of separator:

There are different types of sand separator each one are discussed below:

1) Horizontal two phase separator:

Separators are designed in horizontal, vertical, or spherical configurations. Figure 4-1 is a schematic of a horizontal separator. The initial gross separation of liquid and vapor occurs at the inlet diverter. The fluid enters the separator and hits an inlet diverter causing a sudden change in momentum. The force of gravity causes the liquid droplets to fall out of the gas stream to the bottom of the vessel where it is collected.

Fig. 2: horizontal separator schematic

This liquid collection section provides the retention time required to let entrained gas evolve out of the oil and rise to the vapor space. It also provides a surge volume, if necessary, to handle intermittent slugs of liquid. The liquid then leaves the vessel through the liquid dump valve. The liquid dump valve is regulated by a level controller. The level controller senses changes in liquid level and controls the dump valve accordingly.

2) Vertical Two Phase Separator Basic Design:

In this configuration the inlet flow enters the vessel through the side. As in the horizontal separator, the inlet diverter does the initial gross separation. The liquid flows down to the liquid collection section of the vessel. Liquid continues to flow downward through this section to the liquid outlet. As the liquid reaches equilibrium, gas bubbles flow counter to the direction of the liquid flow and eventually migrate to the vapor space. The level controller and liquid dump valve operate the same as in a horizontal separator.

Fig. 3: vertical separator schematic

The gas flows over the inlet diverter and then vertically upward toward the gas outlet. In the gravity settling section the liquid drops fall vertically downward counter to the gas flow. Gas goes through the mist extractor section before it leaves the vessel. Pressure and level are maintained as in a horizontal separator.
3) **Spherical Two Phase Separator Basic Design**

A typical spherical separator is shown below. The same four sections can be found in this vessel. Spherical separators are a special case of a vertical separator where there is no cylindrical shell between the two heads. They may be very efficient from a pressure containment standpoint but because (1) they have limited liquid surge capability and (2) they exhibit fabrication difficulties, they are not usually used in oil field facilities. For this reason we will not be discussing spherical separators any further.

![Spherical Separator Schematic](image)

**Fig. 4:** spherical separator schematic

A ball-shaped vessel used for fluid separation. A spherical separator can be used for two-phase or three-phase separation purposes. Spherical separators are less efficient than either horizontal or vertical cylindrical separators and are seldom used. Nevertheless, their compact size and ease of transportation have made them suitable for crowded processing areas.

### III. CLASSIFICATION OF SEPARATOR BY APPLICATION

**A. Classification by application**

Oil and gas separators may be classified according to application as test separator, production separator, low temperature separator, metering separator, elevated separator, and stage separators (first stage, second stage, etc.).

**B. Test separator:**

A test separator is used to separate and to meter the well fluids. The test separator can be referred to as a well tester or well checker. Test separators can be vertical, horizontal, or spherical. They can be two-phase or three-phase. They can be permanently installed or portable (skid or trailer mounted). Test separators can be equipped with various types of meters for measuring the oil, gas, and/or water for potential tests, periodic production tests, marginal well tests, etc.

**C. Production separator:**

A production separator is used to separate the produced well fluid from a well, group of wells, or a lease on a daily or continuous basis. Production separators can be vertical, horizontal, or spherical. They can be two-phase or three-phase. Production separators range in size from 12 in. to 15 ft in diameter, with most units ranging from 30 in. to 10 ft in diameter. They range in length from 6 to 70 ft, with most from 10 to 40 ft long.

**D. Low-temperature separator:**

A low-temperature separator is a special one in which high-pressure well fluid is jetted into the vessel through a choke or pressure reducing valve so that the separator temperature is reduced appreciably below the well-fluid temperature. The temperature reduction is obtained by the Joule-Thomson effect of expanding well fluid as it flows through the pressure-reducing choke or valve into the separator. The lower operating temperature in the separator causes condensation of vapors that otherwise would exit the separator in the vapor state. Liquids thus recovered require stabilization to prevent excessive evaporation in the storage tanks.

**E. Metering separator:**

The function of separating well fluids into oil, gas, and water and metering the liquids can be accomplished in one vessel. These vessels are commonly referred to as metering separators and are available for two-phase and three-phase operation. These units are available in special models that make them suitable for accurately metering foaming and heavy viscous oil.

### IV. WORKING OF SAND SEPARATOR

Sand Separator removes produced solids from the well effluent. Depending on the well pressures and the working pressure of the vessel, the sand separator may be situated after, or before, the choke manifold in a production testing system layout. Typically, the well effluent exits the choke manifold, after a pressure drop at the choke, and enters the sand separator. At the
inlet to the sand separator, the flow diverter causes the well effluent to flow tangential to the wall of the separator. The fluid spins about the wall of the separator creating a centrifugal force. Centrifugal force causes solids to separate because of the difference in the solids and well effluent density. Gravitational force causes the solids to drop to the bottom of the separator. On its flow path to the top outlet, the well effluent encounters strainers to eliminate residual solids, while exiting the top outlet. Accumulated solids are removed at desired intervals from the bottom drain outlet by controlled use of an adjustable choke. The vessel incorporates a relief valve and a rupture disk for overpressure protection.

A sand filter cleans your pool water by a process known as depth filtration. As dirt and other debris get into the sand bed, they get trapped in the tiny spaces that are between the sand grains.

V. ANALYSIS OF BACKWASHING

A. How To Backwash a Sand Filter

All the sand filters use the same mechanics: when they are set to filter, water will flow from the pool via the filter and then back into the pool. The sand that’s in the filter system will block dirt, oil and debris. A normal sand filter multiport usually has 6 various settings; filter, circulate backwash, rinse, waste and closed. But when you vacuum your pool, a lot of dirt and debris is deposited in the sand. What results is a dirty and clogged sand filter that if not checked, it will reduce the ability of the sand to filter and get back again into your pool.

Backwashing the sand filter will prevent this. The backwash will change the way the water is flowing, raising up and rinsing the sand and then getting rid of the dirty water through a waste line right into the drain or ground. To be sure there’s no residual blowback into the pool, after you have finished backwashing it, it’s important that you rinse the filter. As the backwash raises and cleanses the sand, the cleanse goes back into the sand in its original position for effective filtration.

B. How to backwash a sand filter

- Turn off the pump
- Close the valves that are located in the suction and the return lines
- Unlock the cover of the pump and pour out the filter basket
- Lock the cover
- Open the valve that leads to the drain outlet
- Turn around the lever to backwash
- Open the suction valves and return lines
- Start the pump. Cleanse the filter for about 2 minutes or until the water visible is crystal clear. NOTE: All electric heaters must be off
- Turn off the pump
- Turn around the lever to rinse, restart the pump and cleanse for approximately 30 seconds. Turn off the pump and then turn the lever to filter. This is usually the usual operating position.
- Turn off the drain outlet valve and start the pump. If you have an electric heater, switch it on.
C. How regularly should you backwash a pool sand filter

Your pool sand filter should be backwashed and rinsed off once in a week but this depends on how heavily your pool is used. The best time to do this is usually immediately after you have vacuumed the pool. If your pool has been used more than it is normally, then it’s advisable to backwash two times in a week.

In addition, if your pool is located under trees that shed a lot, then you may have to backwash the pool filter frequently as leaves and any other debris from trees and contaminants from insects will be getting into your pool. Still, you can always tell when it’s time to backwash the pool by assessing the sand filter systems pressure gauge. The normal operating pressures are usually from 50 to 75Kpa (kilopascal). However, when the sand gets dirty and clogged up, the pressure reading goes up. If the Kpa pressure on the gauge is appearing high at about 80Kpa, then it means it’s time to backwash your pool sand filter.

D. When should you not backwash the pool sand filter?

If the pool has abnormal high dirt levels for example, due to being neglected over a long period of time, runoff that may occur due to flooding or due to dirt from a construction site nearby, it may be prudent not to backwash the filter. Further, if your water has algae growth, backwashing the sand filter may not be wise. Live algae can easily pass via the filter and then get back into the pool. The same case applies for dead algae after shocking the pool. In the above cases, instead of vacuuming and then backwashing, it would be advisable to waste directly and release the vacuumed water right down into the drain.

E. Backwashing Tips:

- Do not backwash more than its necessary or for extended periods of time. A sand filter system will operate at its best in the middle of the filtration cycle. This is due to the location of the sand filter and also to some extend the built up of gathered debris and dirt in the filter. The effects of too much or frequently backwashing is that the sand filters efficiency is reduced.

- Ensure your pump is always turned off before moving or resting the filter valve setting. If you do not turn off, then you will damage or destroy the entire system.
Since backwashing cleanses out some sand with dirt and debris, it is important to increase more sand in the filter from time to time. When you increase the amount of sand, put the filter system on rinse for a few minutes to decrease the amount of sand blowback into the swimming pool.

The problem of backwashing the sand filter is that since water is removed from the system and released to water, there is water wastage. Although this cannot be avoided, the important thing is not to overdo the backwash process and expel only the amount of water that necessary. Keep an eye on the quality and color of water in the sight glass to avoid water wastage.

F. Features/Benefits:
- Prevents erosive sand and franc prop pant material from damaging process and well control equipment
- Reduces wash-outs in piping, providing a safer operational and test environment
- Flushing of the lower pot can be done while equipment is in service

G. Applications:
- Prop pant removal from gas/condensate developments
- Well cleanup operations
- Well startup operations
- Increase production beyond
- Sand-free production rates.
- Used in micro irrigation systems to remove sand and slit particles from irrigation water.
- Grinding circuits within the mineral processing industry and micro irrigation. The coarse particles return to the mill for re-grinding while the finer products are passed on to a subsequent stage of treatment.

VI. RESULTS
As a result, the design and fabrication of sand separator in bagasse plant has been executed and the hardware output is obtained. Comparison of existing system and proposed system is listed below in order to analyze the results in an efficient manner.

VII. EXISTING SYSTEM AND PROPOSED SYSTEM

A. Existing system
- Manual control
- Unsafe system
- Unreliable system

B. PROPOSED SYSTEM
- Automatic control.
- Wireless technology used.
- Reliable system.
- A Wireless Link between two or more objects.
- Designing a set of protocols for inviolable and robust communication between the modules.

VIII. CONCLUSIONS
The paper reviews erosion prediction and sand accumulation models. The paper will also address issues associated with sand removal and inhibitor performance and effectiveness when sand accumulation occurs. It enhances the life of plug screw to facilitate paper production rate high.

REFERENCES
[4] Isidro Calvo, Fernando Lopez, Ekaizt Zulu, Pablo Gonzalez-Nald, Towards a methodology to build sand separator manufacturing systems based on free open software technologies, International Journal of