



The Importance of Flow Meter Installation on Fuel (PMS, AGO & PK) Trucks Loading from Lagos Tank Farm to Prevent Drains

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ABSTRACT

The study investigated the importance of flow meter installation on fuel (PMS, AGO & PK) trucks loading from Lagos tank farm to prevent drain. It is exploratory study and adopted purposive sampling method in selecting two oil and gas companies in Lagos state from where fifty respondents comprising the employees of the selected companies, fuel tanker drivers and company engineers resulting in a total of 100 respondents. Self-made questionnaire was adopted for data collection and data so collected were analyzed using frequency and percentages. The result of the study indicated the following challenges as associated with mechanical meters: high installation cost; wear out of expensive rotating parts; require regular maintenance; sensitive to changes in process parameters; low level of accuracy; poor metering could lead to losses of products; and abnormally high readings of meter could lead to over payment. A second finding of the study revealed the following as the effect of installing flow meter on fuel trucks to prevent drains: Improves verification exercise; Provides a direct measurement of mass flow rather than volume; Enhance flow metering accuracy; Measurement is independent of density, viscosity, and flow profile; and Ease in prediction of depletion. The result above indicated that installing flow meters on fuel trucks helps in preventing drains. From the findings of this study, the following recommendations were made: repair/replace faulty meter components; meters must never be used to measure flow exceeding their capacity; filtering equipment must be installed in the lines preceding the meters to prevent abrasive materials from getting into the blade cavities; during servicing, any foreign deposit should be removed before the meter reassembled; and meter performance chart must be kept for each meter in use.

Keywords: flow meter, installation, fuel (PMS, AGO & PK), trucks loading, tank farm, prevent drain.

Introduction

In the production and distribution of crude oil, tank farms, oil terminals and pipelines handle millions of barrels of crude oil, and with the activities involved, these facilities require a lot of capacity to make them effective in the discharge of their duties and to cope with the increasing flow of crude oil. A major hindrance to this increased capacity is in the use of flowmeters to handle the increasing flow. A flow meter also referred to as flow sensor describes an instrument deployed in the measurement of mass, linear, nonlinear, mass or volumetric flow rate of a liquid or a gas (Mark, 2019). Metering in oil and gas is important as it enables operators determine their actual production rates as well as enable the easy prediction of well depletion which equips them with the ability to make plans for long term production rates.

For decades, mechanical meters have been in use and are characterized by heavy and large parts, possession of dirt filters, easily damaging expensive rotating parts, constant maintenance, inability to work with gas and as well as smart instruments. The use of mechanical meters are thus limited by high cost of installation and sensitive to changes in process parameters such as viscosity and pressure, and need for maintenance arising from parts issues; all of which prevents efficiency and causes downtime (Abbasi, Benhelal & Ahmad, 2014). In view of these challenges, terminals and tank farms seek the use flowmeters that are compact, easily repairable, possess exceptional accuracy and advanced features, to enhance efficiency in operations.

Statement of research problem

With increased production of crude oil, challenges are experienced in oil terminals, distribution facilities and tank farms. This challenge is caused by the use of conventional flowmeters which usually causes flow restrictions. In spite of the importance attached to flow meters in oil and gas production and distribution, it is usually not installed with proper documentation and maintenance schedules (Walton, 2020). Furthermore, given the rise in the fluctuation of crude oil and the cost of production, it has become important to improve fluid flow rate metering to enhance the accuracy and precision in oil and gas production and distribution. To this end, this study examines the importance of flow meter installation on fuel (PMS, AGO & PK) trucks loading from Lagos tank farm to prevent drains.

Research objectives

The specific objective of this study is to;

1. Identify the challenges with mechanical meters.
2. Assess the effect of installing flow meter on fuel trucks to prevent drains.
3. Suggests ways to enhance the use of flow meter in fuel trucks

Research questions

1. What are the challenges with mechanical meters?
2. What is the effect of installing flow meter on fuel trucks to prevent drains?
3. What are the ways to enhance the use of flow meter in fuel trucks?

Literature review

A flow meter is used in the measurement of fluid transported from an oil facility or tank farm to a designated location. It possesses a visual display, mechanical or digital, to aid in accurate measurement (Centre Tank Services, 2021). It is used in diesel refueling system, to gauge the quantity of fuel transferred during a specific transaction to enable users know the level of fuel dispensed. Flow measurement, regardless of the state of the liquid or gas is an important determinant in operations to derive an accurate result and determine product quality. In addition to this, is the factor of health and safety of personnel. In working with gas, it is important to provide employee with a safe environment that can aid their productivity, and to this end, the measurement of flow and provide provides the required knowledge and security (Walyon, 2020). Flow meter enables the accurate prediction of depleted stocks as well as enhances the control of production rates.

A tank farm also referred to as oil terminal or oil depot is an industrial facility used in the storage of oil products as well as a transportation point to other locations or storage facilities. A tank farm contains tanks, which are built either below or above the ground and serve as a point from which products are discharged into other vehicles, tankers or pipelines. The site of tank farms is usually in locations from which tankers bearing products can easily discharge their cargo. In the logistics of crude oil tank farms reduce the effect of demand spikes, and as such serve as an energy trading tool (Abbasi et al., 2014).

Orij and Odagme (2015) investigated the application of metering process in oil and gas production in Niger delta fields. It was disclosed that poor metering could cause product loss as well as over payment when the meter gives off a high reading. The findings of the study indicated that regular recalibration and supervision of meters can improve metering and prevent undue error readings.

Theoretical: Measurement theory

Measurement theory is concerned with the delegation of numbers to objects and phenomena. It explains the various things that can be measured and the relationship between different measures, as well as enable identification of errors in the measurement process. Measurement theory identifies with three main issues; error; representation (number assignment); and uniqueness. The measurement theory can be traced to the 4th century BC, and was incorporated into the social sciences in the 18th century, by Jeremy Bentham, a British utilitarian moralist (Britannica, 2020). The rationale behind the measurement theory is the problem of error. It was once a belief that measurement errors can be eliminated by refining scientific principles and equipment. This belief has been eradicated by most scientists, and at present most physical measurements are accompanied by proof of the extent of an error. Categories of error that can be considered are errors of observation such as personal, instrumental, random and systematic errors, direct and indirect; and sampling errors.

Methodology

The study is an exploratory study meant to investigate into the importance of flow meter installation on fuel (PMS, AGO & PK) trucks loading from Lagos tank farm to prevent drain. Purposive sampling method was used in selecting three oil and gas companies in Lagos state. Using the random sampling method, fifty respondents comprising of employees of the company, fuel tanker drivers and company engineers were each selected, making a total of 100 respondents, the instrument for data collection was questionnaire developed on a four scale likert format and distributed to the respondents. The data gathered was descriptively analyzed using frequency and percentages.

Data presentation and analysis

RQ1 What are the challenges with mechanical meters?

Table 1: The challenges with mechanical meters

ITEMS		SA	A	D	SD	Percentage in agreement
High installation cost	F	50	47	0	3	97.0
	%	50.0	47.0	0.0	3.0	
Wear out of expensive rotating parts	F	44	52	1	3	96.0
	%	44.0	52.0	1.0	3.0	
Require regular maintenance	F	29	63	3	5	92.0
	%	29.0	63.0	3.0	5.0	
Sensitive to changes in process parameters	F	30	57	10	3	87.0
	%	30.0	57.0	1.0	2.0	
Low level of accuracy	F	70	22	6	2	92.0
	%	70.0	22.0	6.0	2.0	
Poor metering could lead to losses of products	F	50	45	3	2	95.0
	%	50.0	45.0	3.0	2.0	
Abnormally high readings of meter could lead to over payment	F	33	62	5	0	95.0
	%	33.0	62.0	5.0	0.0	

Field survey 2021

Table 1 above presents the challenges associated with mechanical meters. Among these are: High installation cost (97%); Wear out of expensive rotating parts (96%); Require regular maintenance (92%); Sensitive to changes in process parameters (87%); low level of accuracy (92%); Poor metering could lead to losses of products (95%); and Abnormally high readings of meter could lead to over payment (95%).

RQ2 What is the effect of installing flow meter on fuel trucks to prevent drains?

Table 2: The effect of installing flow meter on fuel trucks to prevent drains

Items		SA	A	D	SD	Percentage in agreement
Improves verification exercise	F	44	52	1	3	96.0
	%	44.0	52.0	1.0	3.0	
Provides a direct measurement of mass flow rather than volume	F	29	63	3	5	92.0
	%	29.0	63.0	3.0	5.0	
Enhance flow metering accuracy	F	30	57	10	3	87.0
	%	30.0	57.0	1.0	2.0	
Measurement is independent of density, viscosity, and flow profile	F	70	22	6	2	92.0
	%	70.0	22.0	6.0	2.0	
Ease in prediction of depletion	F	50	45	3	2	95.0
	%	50.0	45.0	3.0	2.0	

Field survey 2021

The responded supported the following as the effect of installing flow meter on fuel trucks to prevent drains: Improves verification exercise (96%); Provides a direct measurement of mass flow rather than volume (92%); Enhance flow metering accuracy (87%); Measurement is independent of density, viscosity, and flow profile (92%); and Ease in prediction of depletion (95%). The result above indicated that installing flow meters on fuel trucks helps in preventing drains.

RQ3 What are the ways to enhance the use of flow meter in fuel trucks?**Table 3: Ways to enhance the use of flow meter in fuel trucks**

Items		SA	A	D	SD	Percentage in agreement
Repair/replace faulty meter components	F	29	63	3	5	92.0
	%	29.0	63.0	3.0	5.0	
Meters must never be used to measure flow exceeding their capacity	F	30	57	10	3	87.0
	%	30.0	57.0	1.0	2.0	
Filtering equipment must be installed in the lines preceding the meters to prevent abrasive materials from getting into the blade cavities	F	70	22	6	2	92.0
	%	70.0	22.0	6.0	2.0	
During servicing, any foreign deposit should be removed before the meter reassembled	F	50	45	3	2	95.0
	%	50.0	45.0	3.0	2.0	
Meter performance chart must be kept for each meter in use	F	70	22	6	2	92.0
	%	70.0	22.0	6.0	2.0	

Field survey 2021

Table 3 above presents some suggested ways to enhance the use of flow meter in fuel trucks. According to the study, the following ways were recommended: Repair/replace faulty meter components (92.0%); Meters must never be used to measure flow exceeding their capacity (87%); Filtering equipment must be installed in the lines preceding the meters to prevent abrasive materials from getting into the blade cavities (92%); During servicing, any foreign deposit should be removed before the meter reassembled (95%); and Meter performance chart must be kept for each meter in use (92%).

Discussion, Conclusions and Recommendations

This study specifically investigate the importance of flow meter installation on Fuel (PMS, AGO & PK) Trucks loading from Lagos Tank farm to prevent drains. The study emanates from the premise that mechanical meters have been in use and are characterized by heavy and large parts, possession of dirt filters, easily damaging expensive rotating parts, constant maintenance, inability to work with gas and as well as smart instruments (Abbasi, Benhelal & Ahmad, 2014). It is also characterized by the use of mechanical meters are thus limited by high cost of installation and sensitive to changes in process parameters such as viscosity and pressure, and need for maintenance arising from parts issues; all of which prevents efficiency and causes downtime. This study investigated the challenges associated with mechanical meters and found that they are: high installation cost; wear out of expensive rotating parts; require regular maintenance; sensitive to changes in process parameters; low level of accuracy; poor metering could lead to losses of products (95%); and abnormally high readings of meter could lead to over payment. This result confirms that revealed in the study carried out by Abbasi, Benhelal and Ahmad (2014); and Oriji and Odagme (2015) respectively.

The result responded supported the following as the effect of installing flow meter on fuel trucks to prevent drains: Improves verification exercise; Provides a direct measurement of mass flow rather than volume; Enhance flow metering accuracy; Measurement is independent of density, viscosity, and flow profile; and Ease in prediction of depletion. The result above indicated that installing flow meters on fuel trucks helps in preventing drains. On the premise of this results and other findings from this study, the following recommendations were made on how to enhance the use of flow meter in fuel trucks: Repair/replace faulty meter components; Meters must never be used to measure flow exceeding their capacity; Filtering equipment must be installed in the lines preceding the meters to prevent abrasive materials from getting into the blade cavities; During servicing, any foreign deposit should be removed before the meter reassembled; and Meter performance chart must be kept for each meter in use. This study is unique, exploratory and lack literature given that there are fewer studies on the subject.

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Appendix

REQUEST FOR INFORMATION

Dear Respondent,

I am carrying out a study on “The importance of Flow meter installation on Fuel (PMS, AGO & PK) Trucks loading from Lagos Tank farm to prevent drains”, and you have been chosen to be part of the study. This questionnaire is only for academic purposes. Kindly select the response which applies to you and all information will be kept confidential.

Instructions: Please tick (√) as appropriate where

SA = Strongly Agree (SA), A = Agree, D = Disagree (D), SD = Strongly Disagree (SD)

Key: Strongly agree (4), Agree (3), Disagree (2), and strongly disagree (1).

S/N	ITEMS	SA	A	D	SD
RQ1	What are the challenges with mechanical meters?				
1	High installation cost				
2	Wear out of expensive rotating parts				
3	Require regular maintenance				
4	Sensitive to changes in process parameters				
5	Low level of accuracy				
6	Poor metering could lead to losses of products				
7	Abnormally high readings of meter could lead to over payment				
RQ2	What is the effect of installing flow meter on fuel trucks to prevent drains?				
8	Improves verification exercise				
9	Provides a direct measurement of mass flow rather than volume				
10	Enhance flow metering accuracy				
11	Measurement is independent of density, viscosity, and flow profile				
12	Ease in prediction of depletion				
RQ3	What are the ways to enhance the use of flow meter in fuel trucks?				
13	Repair/replace faulty meter components				
14	Meters must never be used to measure flow exceeding their capacity				
15	Filtering equipment must be installed in the lines preceding the meters to prevent abrasive materials from getting into the blade cavities				
16	During servicing, any foreign deposit should be removed before the meter reassembled				
17	Meter performance chart must be kept for each meter in use				