"Safety Performance Monitoring in Pump Manufacturing Industries"

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ABSTRACT:-

In total safety management system it is cumulative effort of the occupier, manager, safety-manager, head of the departments, supervisors, and workers etc. This gives the end result in accident prevention program. Some time it is essential to find out the comparative result of performance of the team for 'past' few years. Therefore we need some techniques for measuring the safety performance. Such type of monitoring or measurement helps us to identify the weakness in implementation of safety program in industries, with view to improve the safety system in future. The measurement of safety performance is useful to all management to know the progress of safety culture. It promotes safety in all walks of life like road safety, home safety, industrial safety and safety at the sea and the sky. The industries are paying crores of rupees every year in terms of workmen compensation and other benefits. Many insurance companies pay the huge amount for accident injuries, deaths, and property damage. If they know the real measurement of safety performance they may try to suggest necessary safety measures to reduce the premium amount.

This type of quantitative monitoring gives clear trend of the industry towards safety. One should find out the main departments which are the unsafe, what are the unsafe actions? How much is money lost and time lost in accidents, etc? So we can easily concentrate upon those areas and provide remedial measures to stop those losses.

Keywords: - Safety performance, Frequency rates, Severity rates, Incidence rates, Accident statistics, Safety culture, Safety leadership.

1. INTRODUCTION

The industrialization has a great contribution in national development. The globalization of trade and business has given us opportunity to improve our national economy by exporting the industrial product. When we explode the foreign markets we find the foreign customer insist our industries to follow the norm of "ISO-18001". To improve the industrial production in quality in quantity is the main goal of our industries, but unfortunate the industrial accident, industrial disaster, occupational diseases, put forth hard deal in production and economy. It also affects adversely the social system of our country, therefore it is urgently necessary to implement safety program and inshore the compliance of safety loss and "ISO-CODES" related to health safety and environment. The safety performance is a key issue for the industries to become a world class competitor. Occupational accidents may lead to permanent disabilities or deaths and economic losses or both. Death of employees or their permanent disability causes economic loss and social problems for employers, employees and their families. Occupational accidents can be reduced through effective preventative measures by investing on safety equipments, training, and educating the employees, process design, and machinery. In order to develop a good safety culture, attitude of the workers needs to be reoriented by adopting best practices, good housekeeping, change in work culture, and work practices. Occupational accidents are common in India like in many other developing countries. The responsibility of the safety in an organizational context must be shared by employers, employees, trade unions, and related state authorities to determine the outcomes of present safety practices. To start with, employers should emphasize on the concept of occupational safety and invest in accident preventative measures. Further, employers and employees should receive awareness raising training so that employees are careful about occupational accidents and act responsibly. In the drastically change of climate, safety has always been a major concern in the Indian industrial setting.

A safety culture is usually regarded as a subset of an organizational climate; similarly, safety performance is considered to be a subsystem of organizational performance. Hence, the safety climate can influence safety performance. The analysis of a perceived safety climate could identify the areas that need to be improved. Employees' perceptions of work safety are associated with variables related to industrial accident rates. Workers who perceived their jobs as safe tended to be involved in fewer accidents than workers who perceived their jobs as dangerous. There are many published reports on safety issues focused on the manufacturing industry and on other industries. Threats to the occupational safety and health in general industries include physical, chemical, biological (including infectious), ergonomic, and social hazards. The safety performance monitoring is the periodic observation of effectiveness and efficiency indicators in order to track the progress of a program toward specified objectives. As an evaluative function, it is likely to focus on aggregate impacts' without tying effects to individual elements. The emphasis tends to be on tracking outcome but not on measuring linkages and drawing conclusions about cause and effect. The purpose of safety performance monitoring is to provide decision makers with relevant information enabling them to take appropriate action to improve program performance. A safety performance monitoring system consists of three major components: Data, Analysis and Action. At an intermediate stage, the effectiveness of a performance monitoring system would be indicated by the extent to

which the results are reflected in managers' decisions and actions. Ultimately, its impact would be measured by the observable improvements in program performance.

2. PROPOSED MONITORING METHOD

The focus in this study is on safety performance monitoring in pump manufacturing industry previous five year (1st April 2008 to 31st march 2013). The data presented in this paper were compiled as a part of a research project. Accident statistics may serve as an important feedback instrument to monitor safety performance. Accident statistics are commonly expressed as rates, per unit population or per unit time worked. Computation of rates requires number of injuries and exposure. Frequency rates express injuries in terms of hours of exposure taking into account actual exposure to the risk, e.g. including overtime hours. Severity rates express the number of days lost in terms of hours of exposure, taking into account the gravity of the injury. Incidence rates express injuries in terms of number of persons exposed to the risk per year. Rates can either be computed for (insured) employees or for workers (insured and uninsured combined). In comparison do statistics of fatalities and serious injuries provide more reliable indices of safety performance. This paper deals with safety performance monitoring. It also examines some of the general limitations of statistics on occupational accidents for the pump manufacturing industry. The purpose is to provide a basis for an informed discussion on the safety performance of pump manufacturing industry, with a perspective on limitations of the data available.

3. ANALYSIS/CALCULATION

Now this data have taken from the pump manufacturing industry.

COLLECTION DATA
From Accident Register and Attendance Register

Sr. No.	Years (1 April to 31 March)	No. of Accident	No. of Reportable Accident	Man Days Lost Due to Reportable Accident	Total Man-Hours Worked	Avg. No. of Employees Present in One Day
1.	2008-09	3	3	23	167808	69
2.	2009-10	2	2	2	167808	69
3.	2010-11	4	4	67	508288	209
4.	2011-12	3	3	23	2081792	856
5.	2012-13	4	4	49	2169344	892

Table no.1

Example (Calculation)

As chosen sr.no.5 from table no.1, year 2012-13.
Details:-

* No. of Accident = 4
  (Taken from accident register,)
* No. of reportable Accident = 4
  (Taken from Accident register)
* Man days lost due to reportable Accident = 49
  (Taken from Accident register)
* Man hours worked = 2169344
  (Taken from Attendance register)
* Avg. no. of employees present in one day = 892
  (Taken from Attendance register)
* Total no. of working days in a year = 304
  (Taken from Attendance register)

We know that—

Total man hours worked = Avg. no. of employees present in one day × No. of working day in a year × 8

$\Rightarrow$ Total man hours worked = 892 × 304 × 8

$\Rightarrow$ Total man hours worked = 2169344

Now…..

* **Frequency Rate:** - It is define as number of disabling accidents per million man-hours worked by factory, in a year.
* Purpose – To know how often disabling accidents occur.

$$\text{Frequency Rate} = \frac{\text{No. of Accident} \times 10^6}{\text{Total Man-hours worked}} \quad \text{"in a calendar year"}$$

$$\text{Frequency Rate} = \frac{4 \times 10^6}{2169344} \quad \text{"in a calendar year"}$$

$$\text{Frequency Rate} = \frac{4000000}{2169344} \quad \text{"in a calendar year"}$$

Frequency Rate = 1.843   "in a calendar year"

* **Severity Rate:** - It is define as number of man days lost per million man-hours worked.
* Purpose – To know how serious the injuries are.

$$\text{S.R.} = \frac{\text{Man days lost due to lost due to reportable Accident} \times 10^6}{\text{Total Man-hours worked}} \quad \text{"in a calendar year"}$$

$$\text{Severity Rate} = \frac{49 \times 10^6}{216934} \quad \text{"in a calendar year"}$$

$$\text{Severity Rate} = \frac{49000000}{2169344} \quad \text{"in a calendar year"}$$

Severity Rate = 22.587   "in a calendar year"

* **Incident Rates:** - It is the ratio of number of accidents to number of employees during the period under review.
* Purpose – To know the simple ratio of number of accidents to number of employees

$$\text{Incident Rate} = \frac{\text{No. of reportable Accident} \times 1000}{\text{Average No. of persons employed}} \quad \text{'in a calendar year'}$$

$$\text{Incident Rate} = \frac{4 \times 1000}{892} \quad \text{"in a calendar year"}$$

$$\text{Incident Rate} = \frac{4000}{892} \quad \text{"in a calendar year"}$$

Incident Rate = 4.484   "in a calendar year"

Similarly……….

The frequency rate, severity rate, incident rates, previous four year.

	CALCULATED DATA				
Sr.No.	Year	Frequency Rate	Severity Rate	Incident Rate	Total Man-Hours Worked
1.	2008-09	17.877	137.061	43.478	167808
2.	2009-10	11.918	11.918	28.985	167808
3.	2010-11	7.869	131.815	19.138	508288
4.	2011-12	1.441	11.048	3.504	2081792
5.	2012-13	1.843	22.587	4.484	2169344

Table no.2

Graphically represented all year frequency rates, severity rates, incident rates-
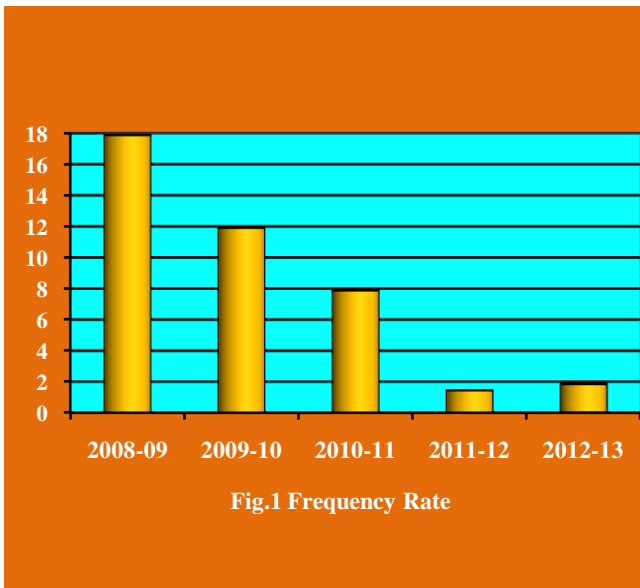
Fig.1 Frequency Rate
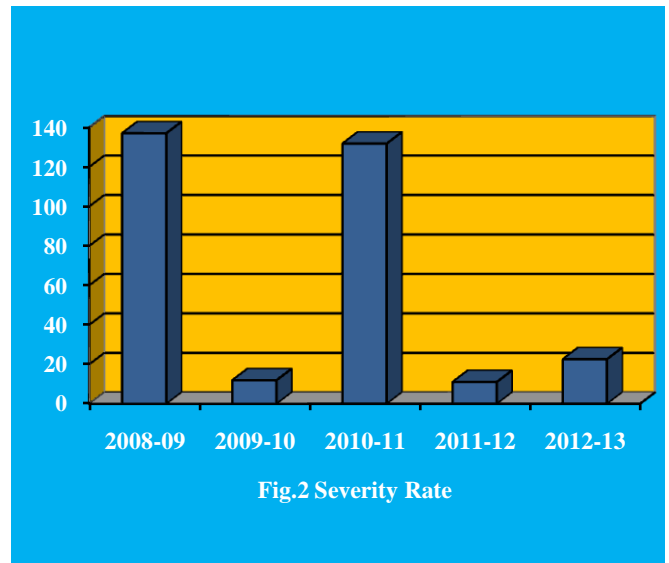
Fig.2 Severity Rate
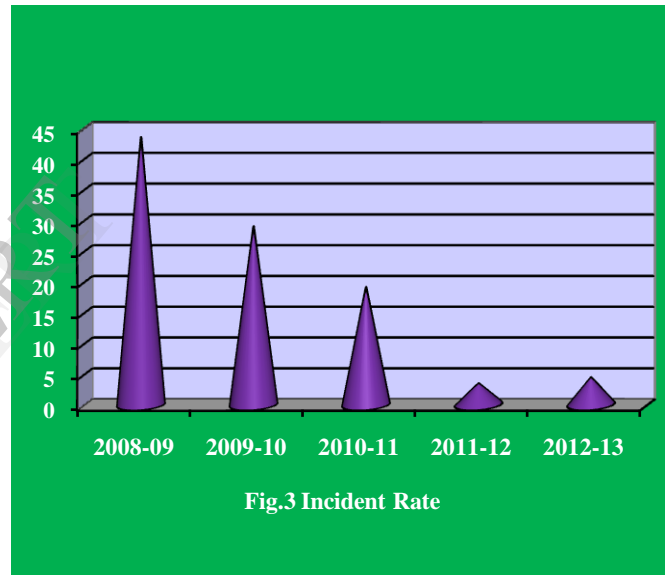
Fig.3 Incident Rate

Now…………

"SAFE-T-SCORE"

$$\text{Safe-T-Score} = \frac{\text{Frequency rate new} - \text{Frequency rate past}}{\sqrt{\dfrac{\text{Frequency rate past} \times 10^6}{\text{Man-hours worked new}}}}$$

Positive (+) STS indicates a worsening record while negative (-) STS indicates an improving record over the past.

STS	It indicates
Between +2 & −2	Change is not significant. There may be random fluctuation only.
More than +2	Record is worsening than it was in the past. Something wrong has happened.
Less than − 2	Record is improving than it was in the past. Something better has happened.

Example (Calculation)……

As chosen sr.no.1, from table no.2, (2008-09) & (2009-10).

$$\text{Safe-T-Score}_{(2009-10)} = \frac{\text{Frequency rate new} - \text{Frequency rate past}}{\sqrt{\dfrac{\text{Frequency rate past} \times 10^6}{\text{Man-hours worked new}}}}$$

$$\text{Safe-T-Score}_{(2009-10)} = \frac{11.918 - 17.877}{\sqrt{\dfrac{17.877 \times 10^6}{167808}}}$$

$$\text{Safe-T-Score}_{(2009-10)} = \frac{-5.959}{\sqrt{106}}$$

$$\text{Safe-T-Score}_{(2009-10)} = \frac{-5.959}{10.321}$$

$$\text{Safe-T-Score}_{(2009-10)} = -0.577$$

Similarly……
The year (2009 and 2010), (2010 and 2011), (2011 and 2012), of Safe-T-Score is

Sr.No.	Years	Safe-T-Score
1.	2009-10	−0.542
2.	2010-11	−0.836
3.	2011-12	−3.267
4.	2012-13	0.493

Table no.3

Now graphically represented…..
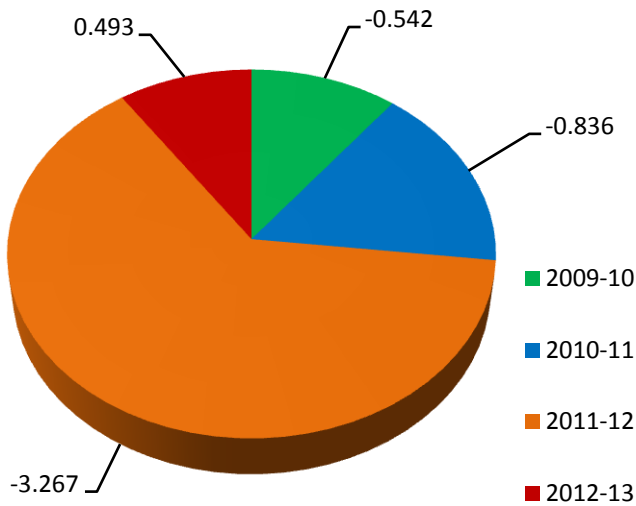
4. SAFETY ACTIVITIES

* **Purpose: -** To compare safety performance of factory with respect to different time periods. Unit time period may be a month, year etc.
* **Definition: -** Safety activity number is the sum of safety activities in a year, with respect to man hours worked and average number of employees.
Safety Activity Numbers $= \sum N = N_1 + N_2 + N_{3+}\ N_4 + \dots\dots\dots$
* **Formula: -**

$$\text{Safety Activity Rate} = \frac{\text{Safety Activity Number} \times 5 \times 10^6}{\text{Man-Hours Worked} \times \text{Avg. No. of Employees}}$$

The parameters for safety activity as follows.
- No. of safety recommendations mentioned in safety audit report, are complied with (N_1).
- No. of unsafe practice detected (N_2).
- No. of unsafe condition detected (N_3).
- No. of statutory compliances carried out (N_4).
- No. of safety committee meeting held (N_5).
- No. of training session of health & safety arranged internally (N_6).
- No. of training session of health & safety done trainer being external agency (N_7).
- No. of mock drill of on-site emergency planning conducted (N_8).
- No. of safety motivation programmers like safety arranged (N_9).
- No. of suggestions for safety received from employees (N_{10}).

5. NEAR-MISS INCIDENTS

The near-miss incidents mean any unplanned, sudden event that could have caused injury or damage to man, materials (plant), but not resulted in any accident. We must learn from near-miss incidents and accidents to prevent recurrence. The first step in the learning process is investigation to determine the causes and underlying reasons why near-miss incidents and accidents occur. A thorough investigation of root causes will identify the management system weaknesses. Learning which management system weaknesses are leading to near- miss incidents and accidents is one of the highest value activities in which a company can invest, and learning from near misses is much cheaper than learning from accidents. Many manufacturing industry should improve safety management systems, and they should begin to focus on getting near-miss incidents report and on root cause analysis. This is a very exciting trend. So one should make groups of five employees from each department and taking the all information about the near-miss incidents in every week improve the safety system in future.

6. MOTIVATION
(Accident free period zero)

The factory management should reward to those workers having zero man-days lost in accidents in span of 12 months. Employee motivation is a process or program employers can initiate to motivate employees. Employers motivate employees to work harder or to reduce near-miss incidents. Although the term 'benefits' is becoming a term of the past, a benefits package is a great way to motivate employees. Incentives are also a great way to produce hard working employees and motivate all to become the best employees. Motivating an employee is a personal mix of seven key strategies. These include, setting expectations, effective punishment, fair treatment, rewards, employee needs, work related goals and restructuring jobs.

7. PUNISHMENT

(Repeated faults endangering himself & fellow workers)

The factory management should punish to incorrigible workers who are not reliable & may repeat the unsafe acts leading even to disaster.

CONCLUSION

This article discusses safety performance monitoring in the pump manufacturing industry during previous five year, from 1st April 2008 to 31st March 2013. With the help of this monitoring method I calculated all year of frequency rate, severity rate, and incident rate and also calculate the Safe-T-Score of 2009-10, 2010-11, 2011-12, 2012-13 and the Safe-T-Score of 2009-10 (−0.542), 2010-11 (−0.836), 2011-12 (−3.267) and 2012-13 (0.493). After monitoring the safety performance status is cleared, because when we got the negative value of Safe-T-Score (Less than −2) that time the record is improve than it was in the past. Something better has happened or the positive value of Safe-T-Score (More than +2) that time the record is worsening than it was in the past. Something wrong has happened or the Safe-T-Score between +2 & −2 that time change is not significant. There may be random fluctuation only. So the year of 2009-10 and 2010-11 the safety performance record is improved than it was in the past. Something better has happened. In year 2011-12 and 2012-13 the safety performance change is not significant. There may be random fluctuation only.

So with help of this monitoring we can say the safety performance was good but management should try to make safety performance status better or improve. In the safety management various elements are there like safety policy, safety committee, safety organization, planning and implementation, safety audit, safety sampling, safety survey etc. they are helpful in reducing the work place hazards, control the accident, and occupational diseases. Including the safety management in industry many accidents, hazards and occupational diseases are reduces, it can be provide information to each and every worker about the various hazards in the workplace and provide the good solutions for controlling those hazards. Provide proper training to the every employer to identify and control hazards. So with the help of the safety performance monitoring or measurement to implementation of safety program in pump manufacturing industries and improve the safety system in future.

ACKNOWLEDGEMENT

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