

HAZOP STUDY ON SEWAGE TREATMENT PLANT AT EDUCATIONAL INSTITUTION

Ashok kumar.S¹, Prakash.J²

¹PG Scholar, Knowledge Institute of Technology, Salem, Tamilnadu, India

² Asst. Professor, Department of Mechanical Engineering, Knowledge Institute of Technology, Salem, Tamilnadu, India

Abstract

The goal of sewage treatment plant is to remove as much of solid, liquid and gaseous contaminants as possible with technical feasible and financially achievable constraints. In this project HAZOP study is done on the sewage treatment plant pipe line flow situated in educational institution. Normally the collected waste water entered in to the sewage treatment plant. So that it remove the contaminants from the waste. Therefore the treated water is used for irrigation in agriculture field. If the plant fails the waste water directly entered in to the soil and causes the soil contamination. This HAZOP study reveals the deviation occur in the pipe line flow that causes the failure of the plant and to prevent the land contamination.

Keywords: Hazop, Aeration Tank, Guide Word, etc...

-----***-----

1. INTRODUCTION

In sewage treatment plant there are variety of process used to remove the contaminants from waste water including sedimentation, coagulation, aeration disinfection and sludge treatment. the specific hazards associated with each process various depending on the design of treatment plat. There are two basic type of waste water enter in to treatment plant human /animal waste and industrial waste. Human excrete about 250 grams of solid waste per capita per day including 2000 million coli form and 450 million streptococci bacteria per person per day. Domestic waste water might contains an organic material utensil washing in kitchen , soap and detergents and the main components are being protein carbohydrate ,oil and grease and other dissolve and suspended compounds.

HAZOP is a preliminary quantitative analysis technique to identify the hazards in a flow process and to evaluate the problem. In HAZOP study guide words are used to generate the possible deviation from normal operating condition through this deviation, safe guard action has been taken to prevent this accident.

2. LITERATURE REVIEW

P K. Ikehata, Y. Liu.,(2012) published a paper LAND DISPOSAL OF WASTE : this paper said that Wastes are generated from every human and animal and the waste are disposed with or without the treatment . There are many technique used for the disposal of waste. Due to improper maintenance and operation the disposed waste contaminate the water , air and soil in the disposal sites around the world and create the infection. Young children are especially vulnerable to these type of hazard.

Fengwang et.al., (2012) published a paper on the A novel knowledge database construction method for operating guidance expert system based on HAZOP analysis and accident analysis .An expert system for operation guidance will help us to identify the problem in an operation and information stored in an expert system will help us to find the solution for that operational problem and technical problem. Obtaining and storing as much as information in the data base of the expert system is an important issue in the construction process. But for accident analysis it contains a limited number of accident cases. So it is important to do the HAZOP analysis to prevent the accident.

After doing the HAZOP analysis for that particular process the collected information is stored in the expert database system. Then these database is used to forecast the accident and cause of the accident.

Faisal I khan et.al.,(2000)published a paper on the title towards the Automation of HAZOP with a new tool EXPERTOP . In the HAZOP study the guide words are used to identify the failure .the guide word will cover the overall malfunctioning of plant .the guide words are

- NONE
- MORE OF
- LESS OF
- MORE THAN
- OTHER
- THAN

NettaLiinRossing, Morten Lind, Niels Jensen, Sten Bay Jørgensen.,(2009)” published a paper on A GOAL BASED HAZOP ASSISTANT .This paper tell that HAZOP is a functional model used to assist in functional decomposition of plant. This study HAZOP also implement in the pipe line

flow of plant or process. The flow such as liquid transport, gas transport, liquid storage ,gas liquid contacting etc. by arising the deviation using the guide word will facilitate the root cause of the failure of process. It is an very efficient tool to reveal the potential hazard in safety critical operation.

3. SEWAGE TREATMENT PLANT

In the sewage treatment plant ,the air filter , filters the atmospheric pressure and then it passes to the compressor. The compressor compress the air and it passes to the aeration tank through pressure relief valve and control valve. The sludge enter in to the screen bars. Here the solid waste in the sludge are staged in the screen bars. And through the control valve it passes to sedimentation tank. here the particles or sludge allowed to settle down under the effect of gravity. The thicker layer of the sludge gets settled down in this chamber and other floated waste will passes out from sedimentation tank. Then it passes to aeration tank for the purpose of aeration .

The aeration tank consists of three chambers namely aeration chamber, sludge holding chamber and equalization chamber. It is an aerobic process. In the aeration tank , the tank have aeration system built on the bottom through these openings the air can be supplied from pump. Then the entered sludge mixed up with air. So that the bacteria will form in the presence of oxygen. Under the aerobic condition ,bacteria rapidly consumes organic matter in the waste and convert it in to carbon dioxide. Then the collected sludge will settled in the sludge chamber. Then the aerated liquid will passes to the equalization chamber. Here the chemicals ,activated sludge, and other agents are mixed. Then the treated will come in the outlet and used for the purpose of irrigation.

3.1 Hazop Study

The term hazop refers to hazard and operability study. It is a brain storming tool and often describes brain storming tool, and it is a bottom up risk identification approach where success relies on the subject matter to predict the deviation based on the past experience and general subject matter expertise. This is one of the quantitative hazard identification techniques. HAZOP study is done systematically with appropriate skilled team people to identify the operational problem and potential hazards arise in the plant. By using this technique we can find out the deviation occur apart from normal operating condition of plant. The investigation technique can used to manage the design and construction risk related aspects concerning the design intent and operation of the process.

Table -1: Name of the Table

| Guide Word | Meaning |
|------------|--|
| NO OR NOT | Complete negation of the design intent |
| MORE | Quantitative increase |
| LESS | Quantitative decrease |

| | |
|------------|---------------------------------------|
| AS WELL AS | Qualitative modification/increase |
| PART OF | Qualitative modification/decrease |
| REVERSE | Logical opposite of the design intent |
| OTHER THAN | Complete substitution |

4. OBJECTIVE AND BENIFITS

The objective of the HAZOP stud are To identify the potential hazard in a plant or process to Workers health and safety. Operation failure result in down time. Product quality. Environment pollution. Record the previous design and safeguard technique to prevent the above mentioned hazard. To deduct the further safeguard technique .to determine the clear action to improve the safety and operability of plant and process.

A hazop analysis cover the entire life cycle stage of plant or equipment it covers the concept and location selection, detailed design, construction and installation ,commissioning, operation, decommissioning and site cleanup. The benefits of hazop study are identification of hazard and awareness, causes of potential failure , identification of potential hazard that cause operational failure, identification and mitigation of risk ,improved operational efficiency and reliability

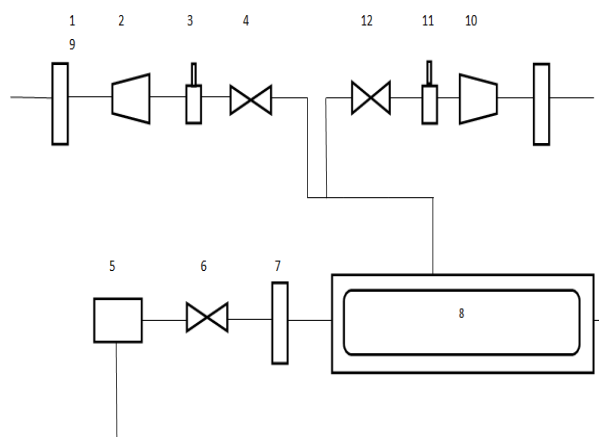


Fig 1 Flow Diagram of Sewage Treatment Plant

- 1, 9 - Air filter
- 2, 10 -Compressor
- 3, 11 -Pressure relief valve
- 4, 12 -Control valve
- 5 -Screen bars
- 6 -Control valve 2
- 7 -Sedimentation tank
- 8 -Aeration tank

5. RESULTS AND DISCUSSION

NODE: 1 Air supply to the aeration tank
 The node 1 is diverted in to deviation namely decreased pressure, no power supply, increase pressure.

| GUIDEWORD | DEVIATION | CAUSES | CONSEQUENCE | ACTION |
|------------|---------------|---|---|--|
| Less of | flow | Partially blocked air filter | Efficiency decreases Air pressure reduced | Clean the filter at a particular interval. |
| As well as | composition | Filter damaged incorrectly installed | Failure of system | Use of quality filter. Periodic maintenance. Competence person has to be install the filter. |
| No/none | flow | Compressor failure No power supply to pump | Air supply to aeration tank will be blocked. Pump gets stopped due to power failure. | Preventive maintenance has to be taken. Alternative power system placed in case of power failure. |
| More | More pressure | Failure of compressor control | Higher tank pressure | Pressure alarm |
| Not | Flow | Control valve closed | Increased pressure in compressor | Pressure relief valve in compressor |

| GUIDEWORD | DEVIATION | CAUSES | CONSEQUENCE | ACTION |
|------------|-----------|--------------------------------|---|---|
| As well as | Flow | Filter fails to filter | Waste passes to aeration tank without filter. So that heavy particles entered | Quality filter Preventive maintenance Proper installation of filter |
| No/none | Flow | Block in filter | No waste water enter in to tank. Introducing mechanical conveyer to remove the collected waste | Periodic checkup |
| Not | Flow | Control valve closed | Burst of pipe | Periodic valve maintenance . Alarm system is introduced. |
| Not | No flow | Blockage in sedimentation tank | | No flow to aeration tank. Periodical check up Introducing the drain valve to collect the waste. |
| As well as | Flow | Sedimentation process fails | Periodic maintenance | Periodical checkup. Periodic maintenance. |

6. CONCLUSIONS

In this, paper the pipe line flow of the sewage treatment plant has been studied. In this study some safeguard measures are identified by arising the deviation with the help of guide words. The find out safeguard measures are recommended to taken , like attaching the pump with generator in case of power failure, periodic maintenance of filter etc. There fore failure of the sewage treatment plant has been avoided and thus preventing the soil contamination.

REFERENCES

[1]. K. Ikehata, Y. Liu., Land Disposal of Wastes Reference Module in Earth Systems and Environmental Sciences, from Encyclopedia of Environmental Health, 2011, Pages 353-361, Current as of 30 July 2012

[2]. Fengwang et.al., (2012) "A novel knowledge database construction method for operation guidance expert system based on HAZOP analysis and accident analysis "journal of loss prevention in the process industries". vol 25, pp 905-915.

[3]. Faisal I khan et.al.,(2000) "Towards automation of HAZOP with a new tool EXPERTOP" environmental modeling & software vol 15 , pp 67-77.

[4]. NettaLiinRossing, Morten Lind, Niels Jensen, Sten Bay Jørgensen.,(2009) "A goal based HAZOP assistant" Computer Aided Chemical Engineering, Volume 26, 2009, Pages 1129-1134