Risk & Safety Assessment of Anaerobic Digestor

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Aim of the Project

The Aim of the project is to perform a range of safety assessments on the design of an anaerobic digestor at users' point of view

Background

Anaerobic digestor plant is a machine that breaks down organic waste with microorganism without the present of oxygen. The anaerobic digestion process produces biogas and digestate. Biogas can be purified and used as energy source of electricity, heating, and transportation fuel.

However, using or operating an anaerobic digestor might cause several potential safety hazards to users. For example, fire and explosion, risk of asphyxiation, high pressure gas or liquid leaks and chemical hazards. Hence, risk and safety assessments must be performed on the pre-existing model that was designed last semester to identify and eliminate potential risks to the users.

In this project, different risk assessment is carried out to research the potential risks and safety hazards to users of the pre-existing assembly including Process Failure Modes and Effects Analysis (PFMEA), Fishbone Diagram, Pilz Hazard Rating, Pilz User Safety, etc. The analysis of the models includes studying the consequences of failures on the model by rating the potential loss and the probability of occurrence. All the assessment standards were referenced from the European standards such as EN IEC 62061, EN ISO 13849-1, ISO 12100 etc.

Risk Assessment

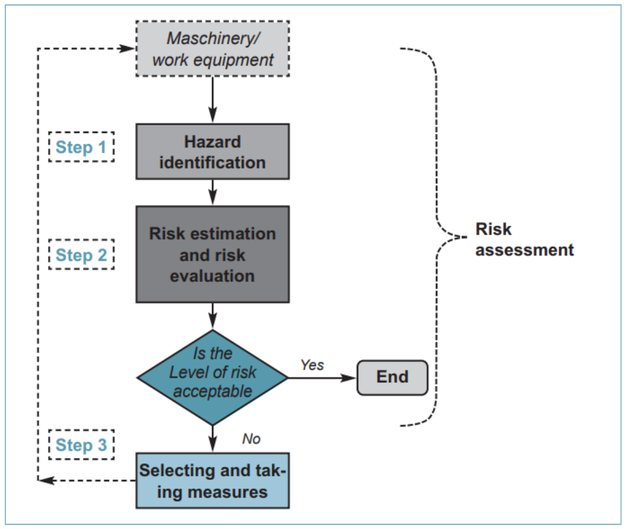

Figure 1: Procedure of risk assessment

In this project, scoring systems of Process Failure Modes and Effects Analysis (PFMEA) and EN IEC 62061: Safety integrity level (SIL) is used to classify the risks level. The scoring systems provide guidelines and standards for assessing the risks and hazards of different machines on users' safety point of view. the fishbone diagram was able to clearly illustrate the reasons of each risk and hazard analysed in the previous analysis.

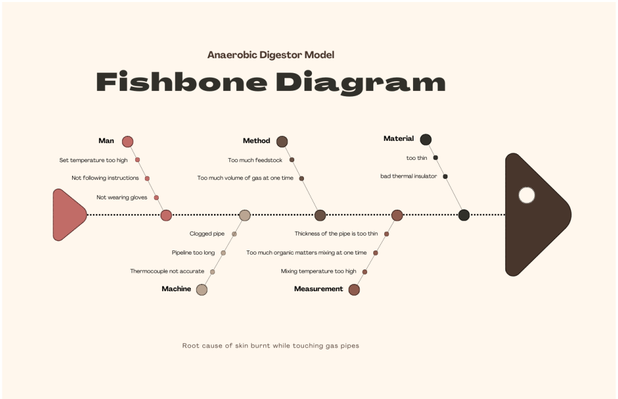

Figure 2: Fishbone diagram for root cause analysis

Ergonomics

Ergonomics evaluation and monitoring were also brought out in this project on the pre-existing model to improve the performance and effectiveness of the work system, while including the workers' health, well-being or safety issues. Ergonomics designed products, machines or workplaces are more comfortable as they considered the users' requirements and movements which helps to minimize stress and discomfort. Different criteria were referenced to evaluate and monitor the pre-existing model such as health and well-being of users, safety, system performance, usability, and cost-benefit.

Health and Safety

Safety precautions are very important for users to prevent incidents wile using the prototype. Safety standards machinery in Europe can be classified into A, B & C standards as shown as figure 3 below. On the other hand, guidelines of designing and building an anaerobic digestor by the Composting & Anaerobic Digestion Association of Ireland was followed in this project. The guidelines outlined the government policies that should be aware while building an anaerobic digestor. Besides, the project also outlined the rules and regulations of running the prototype in a laboratory.

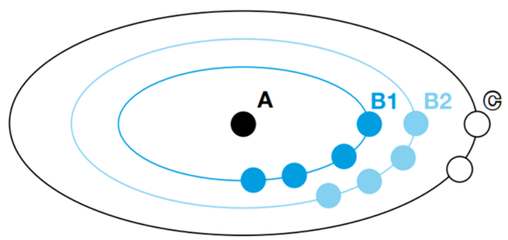

Figure 3: European machinery safety standards structure.

Results

I.D.	Hazard	Fr	Pr	Av	Cl	Se
1	Clogged system	3	4	1	8	1
2	Pressure built up quicker in the tank, catches fire when overheated	4	3	1	8	2
3	Skin burn when touching pipes	4	5	3	12	1
4	Gas leakage - Toxic gas inhaled by user or spreded to the environment	3	3	1	7	3
5	Digestate stuck in the pipe of the pump, causing pump overheated and catches fire	3	4	3	10	2

Figure 4: Rankings of potential risks

The skin burn when touching pipes have the highest risks level out of all five potential hazards. The other potential risk are ranked differently in the PFMEA and the safety standard of EN IEC 62061. The two different method of risk assessment shows different risk levels of the hazards. This provides various of ideas to resolve the issues to ensure users' health and safety. Signs and stickers are performed on the prototype as a result of assessing the risks as well as providing awareness to them.

References

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