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Research Article

Risk Analysis and Risk Assessment of Laboratory Work by Fine Kinney Method

Vedat Karahan[1] and Ercan Aydoğmuş[1*]

[1]*Department of Chemical Engineering, Engineering Faculty, Fırat University, 23119, Elazığ, Türkiye*

[*]*Email of corresponding author: ercanaydogmus@firat.edu.tr*

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Abstract – In this research, risk analysis and evaluation have been carried out using Fine Kinney method within the scope of occupational health and safety. In the risk analysis made in the laboratory, a total of 50 risks are identified. Accordingly, 10 (20 %) are very high risk, 7 (14 %) high risk, 17 (34 %) significant risk, 15 (30 %) probable risk, and 1 (2 %) acceptable risk degree. It is aimed to take these risks under control in laboratory studies and to minimize their effects. Thus, a culture of occupational health and safety should be established and the rules of occupational health and safety should be implemented without compromise. For these reasons, the rules to be observed in laboratory studies are listed below. Employees or researchers involved in laboratory studies should receive occupational health and safety training and this training should be repeated periodically. Emergency plans that may arise from laboratory studies or that may arise from external sources should be prepared, training should be given to team members who are in charge of emergencies, and drills should be carried out periodically. The chemicals used in the laboratory studies should be stored according to their degree of impact, and necessary records should be taken in cases such as use and transportation. Adequate physical environment conditions should be provided for the personnel working in the laboratory studies. Chemical hygiene programs and accident prevention plans should be implemented to prevent accidents.

Keywords – Fine Kinney Method, Occupational Health, Work Safety, Risk Analysis, Risk Assessment

I. INTRODUCTION

Occupational health and safety is a science that is open to continuous innovation, which expresses the importance given to the human being in the constantly developing ecology, production systems, and working life. Occupational health and safety is necessary for a safe working environment with the developing technology and changing production systems as well as legal obligations. Protecting employees against work accidents and occupational diseases and ensuring that employees work in a healthier environment are among the main objectives of occupational health and safety. The concept of occupational health and safety is needed for the safe and healthy execution of production, employee, or service. The basic approach of occupational health and safety is to ensure the health and safety of employees. Employees are exposed to various risk factors, including physical, chemical, biological, and psychosocial in the working environment. For this reason, constantly observing the health of the employees, eliminating the risk factors that may arise from the working environment, and minimizing the

impact levels ensure that the work accidents and occupational diseases of the employees are prevented [1].

There may also be risks, known or unknown, foreseeable or unpredictable, that may arise from the execution of the work in the enterprises and the working environment. These risks hurt production, the working environment, workflow, production tools, and the environment. Occupational health and safety is concerned with all of them. Once a hazard arises in the work environment, it can have unpredictable results. For this reason, necessary measures should be taken to affect the employees, production system, equipment, and environment in case of work accidents and emergencies that may occur. It is necessary to foresee the risks that may arise from the production system and equipment from the working environment, to keep them under control, and to eliminate the risks. Occupational accidents are a very serious problem in the world, negatively affecting people's lives every year. It is a fact that losses can be significantly reduced and losses can be prevented by taking necessary and sufficient precautions on time since losses are a problem in all countries. The purpose of risk management in occupational health and safety is to establish a safety net. This safety net is to prevent the emergence of unknown and unpredictable hazards by collecting information that will provide the most valid and correct approach regarding the causes of work accidents and occupational diseases and the factors affecting them [1].

The obligation of risk assessment in all workplaces belonging to the public institutions and private sector in Turkey has been regulated in subparagraph (c) of the first paragraph of 4. article of the Occupational Health and Safety Law No. 6331, putting the employers under obligation. Occupational Health and Safety Law No. 6331 imposes serious responsibilities not only on employers but also on employees. According to Occupational Health and Safety Risk Assessment Regulation published by the Ministry of Labor and Social Security in 2012, risk assessment has come into effect. Before starting the activities of the workplaces, the design is planned to start from the establishment stage. It has been carried out by identifying and analyzing the hazards and risks and applying the necessary protective measures as a result. Labor Law No. 4857 and Law No. 6331 on Occupational Health and Safety, it has brought with them the obligation to periodically renew the risk assessment studies according to the hazard classes of the workplaces to keep the risk assessment studies constantly up-to-date to make continuous improvements in the workplaces. Due to this legal obligation, the importance given to risk assessment studies has increased [2-4].

All kinds of substances and situations that have the potential for danger affect the risk assessment. It is possible to define systematic approaches for organizing and analyzing all kinds of scientific knowledge and experience to be made on this subject. Risk analysis methods are divided into two groups qualitative and quantitative methods. In quantitative risk analysis methods, numerical methods are used while calculating the risk. In qualitative risk analysis methods, approaches such as the possibility of the threat and the effect of the threat are evaluated with logical methods. Although risk analysis methods are divided into two groups as qualitative and quantitative, they show similarities in practice in general. In all risk analysis methods, it starts with identifying the hazards at the initial stage and then scoring is made according to the parameters found in the risk analysis method. In the risk analysis, after the existing hazards are scored, the hazards are prioritized according to their risk scores. After they are classified, it is aimed to eliminate the hazards or reduce them to an acceptable risk level [5].

Although it is initially divided into two main groups in risk analysis, there are many different risk analysis methods among themselves. These methods are listed as described below.

- Initial Hazard Analysis,
- Occupational Safety Analysis,
- Risk Map,
- Check-List Primary Risk Analysis,
- Primary Risk Analysis,
- Risk Evaluation Decision Matrix Methodology (L and X type matrix),
- Hazard and Operability Methodology,
- Fault Tree Analysis Methodology,
- Possible Failure Types There are many risk analysis methods such as Impact Analysis Methodology,
- Event Tree Analysis,
- Cause-Effect Analysis,
- Fine-Kinney Method, etc.

In risk analysis methods, many parameters such as frequency and detectability can be used, as well as parameters such as probability and severity, while scoring the hazards. Although the parameters used vary according to the risk analysis method, various parameter scales are created [6].

Multiple risks may occur due to chemicals in the laboratory environment, biological factors, differences in work equipment, and studies. It is necessary and important to carry out risk analysis and risk assessment due to situations arising from these and similar parameters.

II. MATERIAL AND METHOD

The main purpose of risk analysis is to find the risks at their source and to determine the risk scores by evaluating them. Accordingly, it is aimed to prevent or minimize workplace accidents and loss of work equipment by taking precautions in enterprises by ordering their importance among themselves. Risk analyses may differ according to the way of working and the nature of the work done in the workplace. One of the frequently used risk analysis methods is Fine Kinney method [6].

The "Mathematical Evaluations for Controlling Hazards" method was revised by Kinney and Wiruth in 1976 and published under the name "Practical Risk Analysis for Safety Management" and is now known as the Fine Kinney method. In this method, there are three parameters in risk analysis: Probability (O), frequency (F), and severity (S). The risk score consists of the product of these three parameters. Obtained risk scores are divided into 5 classes acceptable risk, possible risk, significant risk, high risk, and very high risk [7-15].

In this study, Fine Kinney method is used when evaluating risks. The probability of occurrence for each identified risk has been determined by considering Fine Kinney probability scale seen in Table 1. The recurrence of risks has been evaluated by considering Fine Kinney frequency scale in Table 2. The severity of the risks at the moment they occur is expressed in Fine Kinney severity scale, which is shown in Table 3 [8-17].

Table 1. Fine Kinney probability scale

Probability Value	Chance (Probability of Occurrence)
10	Expected / Certain
6	High/ Quite possible
3	Possible
1	Possible, but low
0.5	Unexpected, but possible
0.2	Unexpected

Table 2. Fine Kinney frequency scale

Frequency Value	Frequency (Repeat exposure to the hazard over time)
10	Almost constantly (several times an hour)
6	Frequent (once or several times a day)
3	Occasionally (once or several times a week)
2	Not often (once or several times a month)
1	Rare (several times a year)
0.5	Very rare (Once a year or less)

Table 3. Fine Kinney severity scale

Violence Value	Violence (Estimated damage to humans and/or the environment)
100	Multiple fatal accidents/environmental disasters
400	Fatal accident / Serious environmental damage
15	Permanent damage, injury, job loss, environmental barriers, complaints from the immediate environment
7	Significant damage, injury, need for external first aid, environmental damage outside land boundaries
3	Minor damage, injury, internal first aid, limited environmental damage on-site
1	Cheap circumvention, no environmental damage

III. RESULTS AND DISCUSSION

In this study, a risk analysis study is carried out with Fine Kinney method. Risk ratings are classified as acceptable risk, possible risk, significant risk, high risk, and very high risk, taking into account the risk values. The results obtained are evaluated with Fine Kinney risk chart and risk score scale in Table 4. Also, in Table 5, the risk level, number of risks, and frequency (%) values are expressed. There were

10 risks (20 %) at very high risk, 7 (14 %) at high risk, 17 at significant risk (34 %), 15 at probable risk (30 %), and 1 at acceptable risk (% 2) has been detected.

Table 4. Fine Kinney risk assessment chart and risk score scale

Risk Value	Risk Assessment Result
400< R	For intolerable risk, necessary measures should be taken immediately or the closure of the facility, building, and environment should be considered.
200<R<400	Fundamental risk, improvements need to be made in the short term (within a few months)
70<R<200	Should be improved in the long term (within the year)
20<R< 70	Possible risks should be kept under surveillance.
R<20	Minor risk, prevention is not priority

Table 5. Degree of risk, number of risks, and frequency (%)

Degree of risk	Number of risks	Frequency (%)
Acceptable (1st degree)	1	2
Possible risk (2nd degree)	15	30
Significant risk (3rd degree)	17	34
High risk (4th degree)	7	14
Very high risk (5th degree)	10	20
Total risk	**50**	**100**

Risks are graded according to the obtained risk scores, and the distribution of risk scores according to risk degrees is shown in Figure 1. Considering the number of risks, the highest risk is in the important risk category. However, when the order of importance is made, the risks with a very high-risk degree and the necessary measures should be taken immediately because they are in the high-risk category. Thus, the risk is eliminated or the risk levels are reduced to the possible and acceptable level by taking the necessary precautions.

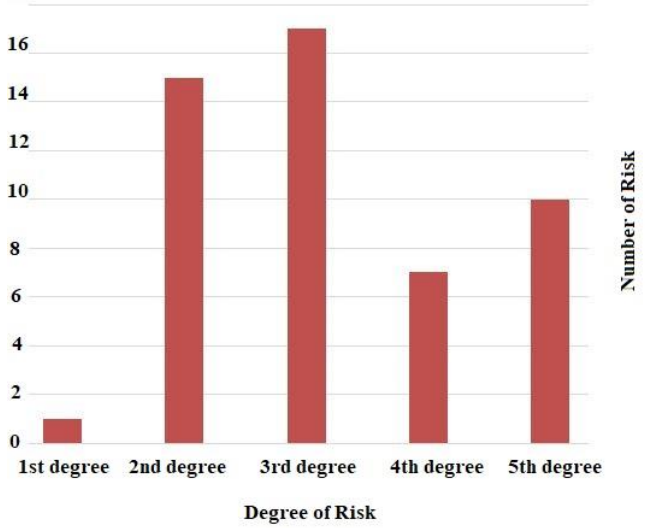

Figure 1. Variation of the number of risks with the degree of risk

IV. CONCLUSIONS

In this study, risk analysis and assessment are carried out in a laboratory environment with Fine Kinney method. This risk analysis study, it is aimed to reveal the hazards and the risks that may arise from them. Risks with a very high, high, and significant degree of risk should be reduced to an acceptable value. Necessary measures should be taken and improvements should be made by legal regulations. It is aimed to eliminate the deficiencies and to provide a healthier and safer laboratory environment [18].

- Emergency and emergency exit plans should be made by taking into account the emergencies that may occur in the laboratories.
- Emergency teams should be determined and emergency drills should be planned periodically by determining emergency escape routes.
- Due to the wide variety of fires that may occur in laboratories, various fire extinguishing equipment should be available for each type of fire.
- Necessary places should be marked, periodic controls of fire extinguishing equipment should be made and periodic drills should be made regarding the fire situation.
- Materials such as glass, metal, and plastic in the laboratory should be distinguished according to the type of analysis devices.
- The identification cards of the analyzers, the persons responsible for them, and the employees must be determined.
- The operating date of these devices, the duration, the nature of the analysis, and each

analyzer should be recorded separately.

- Chemical substances existing in the laboratory or specially supplied for analysis should be stored according to their properties and disposed of after the analysis, taking into account their environmental effects.
- Appropriate personal protective equipment should be provided to employees in laboratory studies, and employees who do not have personal protective equipment should be prevented from working.
- The tubes with the possibility of burning and explosion used for the devices used in the analysis should be used and stored following the legislation.

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