



Risk Management in Hazardous and Toxic Waste Management Companies Using The HIRA (Hazard Identification and Risk Assessment) Method at PT XY Batam City

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The development of industrialization has brought significant negative implications for environmental pollution. This is in line with the quantity and quality of waste produced, which continues to increase, one of which is waste with hazardous and toxic properties. Given the complexity of the negative impacts that may arise from a business or activity that produces hazardous and toxic waste, the need for proper handling of hazardous and toxic waste before disposal into the environment. PT XY is an industry engaged in processing industrial hazardous

and toxic waste. In every process of its activities, it is possible that it can impact humans and the environment. This study uses the HIRA (Hazard Identification and Risk Assessment) method to perform risk management analysis based on the risk assessment results obtained. Researchers found 18 risk findings, with the highest risk value being the risk of fire in the storage area for hazardous and toxic waste due to reactions to the stored hazardous and toxic waste. Meanwhile, the risk finding with the lowest risk value is the risk of the forklift overturning when carrying out the moving drums containing hazardous and toxic waste.

Keywords: Risk Management, hazardous and toxic waste, HIRA (Hazard Identification and Risk Assessment)

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Introduction

The risk of environmental damage is getting bigger, bigger, and more serious. The impact on the environment is related to one or two aspects and affects each other in a subsystem. The development of industry in Indonesia has significantly contributed to the economy (Hameed *et al.*, 2020). On the other hand, it also impacts the environment due to industrial waste disposal and the increasingly intensive exploitation of resources in industrial development. Among the wastes generated from industrial activities, some wastes have hazardous and toxic properties (Nurlani, 2019).

Hazardous and toxic waste has become one of the severe problems in industrialization; according to estimates by World Health Organization, environmental hazards and hazardous waste cause as much as a third of the burden of disease in Africa. Other impacts of hazardous and toxic waste materials have been shown to have severe effects on human health, such as the occurrence of Minamata and Itai-Itai diseases that occurred in Japan. Based on the above, industrial development must be accompanied by environmental management efforts to handle the released waste (Kurniawan, 2019).

Batam City is one of the cities with the most significant industrialization development in Indonesia due to its international trade route. As an industrial development area, Batam City has 24 industrial areas with 1,309 companies from 17 types of business activities. Industrial activities in Batam City are dominated by the manufacturing and electronics industries (BPS Kota Batam, 2019). The increase in annual production and consumption activities in manufacturing activities in Batam City impacts increasing the volume of waste, one of which is hazardous and toxic waste. This industry produces hazardous and toxic waste in electronic waste such as PCB pieces, waste products, solvents, sewage sludge, fluorescent lamps (Hg), expired materials, and waste contaminated with other hazardous and toxic material (Sari, 2018).

The number of industries that continue to increase every year causes an increase in the amount and hazardous and toxic waste produced. According to Attachment IX to Government Regulation of the Republic of Indonesia, Number 22 of 2021 concerning the list of hazardous and toxic wastes from non-specific sources, wastes generated from industrial activities in Batam are classified into hazardous and toxic wastes with categories 1 and 2, this type of waste can cause much more severe environmental damage than other types of waste (Pemerintah Indonesia, 2021). The high amount of hazardous and toxic waste generation in Batam City makes cases of environmental pollution due to waste unavoidable. One of the impacts is the case of pollution on the beach due to the disposal of black oil waste from shipbuilding industry activities (Dinas Lingkungan Hidup Kota Batam, 2020).



Given the various negative impacts of an activity that produces hazardous and toxic waste, early prevention needs to be prioritized. The government has issued a related regulation stating that hazardous and toxic waste management activities are environmental and forestry sector permits designated as risky business activities (Norini and Afrzal, 2017).

The other side of the increasing industrial development in Batam City can be a new investment opportunity to increase economic growth. PT.Y is a company engaged in managing industrial hazardous and toxic waste (transport, collector, storage, and processing) services in Batam City (PT XY, 2020). In carrying out its activities, PT. Y is estimated to have an impact with various levels of risk. One of the efforts to manage the impacts expected to arise at PT.Y can be implemented through a risk management process to minimize losses. Risk management is applied because it will produce more information about organizational risk and result in better management and decision-making (Indragiri, 2018).

The research objectives are (1) to identify and analyze the impact of risk on industrial hazardous and toxic waste management activities at PT XY; (2) conducting a risk management study using the HIRA method at PT XY; (3) Determine the risk control proposal on the findings of risk in hazardous and toxic waste management activities at PT XY.

Methods

This research is observational research by studying the dynamics of the correlation between risk factors and effects. The focus of this research is to focus on the risk management process in hazardous and toxic waste management activities at PT. XY with the help of the HIRA (Hazard Identification and Risk Assessment) method.

The HIRA (Hazard Identification and Risk Assessment) method consists of 4 (four) simple steps: classifying work activities, hazard identification, risk assessment, and risk control (Sijabat and Sunday, 2014). The application of the HIRA method in research is carried out based on the results of risk identification and analysis at each stage of the hazardous and toxic waste management process at PT XY.

Researchers use two types of approaches in this study, namely qualitative and quantitative. Where the data that has been collected is described or described as it is, then the data is measured to determine the level of risk that has been identified. Risk assessment refers to risk management standard AS/NZS 4360:2004, carried out by calculating the likelihood and impact factors with the value scale of each factor, as shown in the following table.

Table 1. Qualitative Measure of “Severity”

Values	Level	Definition
5	Catastrophic	Fatal more than one person, huge losses and



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		the broad impact that has a prolonged impact, the cessation of all activities
4	Major	Serious injury of more than one person, significant loss, production interruption
3	Moderate	Moderate injury, need medical treatment, loss big financial
2	Minor	Minor injury, moderate financial loss
1	Insignificant	No injuries, small financial losses

Table 2. Qualitative Measure of “Likelihood”

Values	Level	Definition
5	Almost Certain	Can happen any time
4	Likely	Moderate probability of occurrence
3	Possible	Can happen once in a while
2	Unlike	Chances are rare
1	Rare	Very rarely happen or never happen

Then the amount of risk can be determined or relative risk. To assess the level of risk, the level of consequence is multiplied by the level of probability of the risk based on the following formula:

$$\text{Relative risk} = \text{Severity} \times \text{likelihood}$$

From the calculation of the relative risk, it can then be determined what actions to handle these risks.

Table 3. Risk Assessment Matrix

		Consequences (Scale)				
		Insignificant (1)	Minor (2)	Major (3)	Hazardous (4)	Catastrophic (5)
Likelihood	Almost certain (5)	5 Supplementary issue	10 Issue	15 Unacceptable	20 Unacceptable	25 Unacceptable
	Likely (4)	4 Acceptable	8 Supplementary issue	12 Issue	16 Unacceptable	20 Unacceptable
	Moderate (3)	3 Acceptable	6 Supplementary issue	9 Issue	12 Issue	15 Unacceptable
	Unlikely (2)	2 Acceptable	4 Acceptable	6	8	10 Issue



			Supplementary issue	Supplementary issue	
Rare (1)	1 Acceptable	2 Acceptable	3 Acceptable	4 Acceptable	5 Supplementary issue

Source: AS/NZS 4360:2004 Risk Management Standard

Explanation:

- Red – *Unacceptable* : Extreme Risk; immediate action required
- Green – *Issue* : High Risk; senior management attention needed
- Yellow – *Supplementary issue* : Moderate Risk; senior management attention needed
- Blue – *Acceptable* : Low Risk; manage by routine procedures

Results and Discussion

Risk management is a coordinated activity designed to guide and control the organization's response to risk, consisting of three processes: risk identification, risk assessment, and risk evaluation.

1. Risk Identification

Risk identification in the management of hazardous and toxic waste at PT XY starts from the preparation stages of waste transportation, waste collection, waste storage, and processing hazardous and toxic waste. Risk identification refers to the existing condition, which is then used as the basis for determining the severity level, likelihood level, and risk level determination. The following are the findings of the risk from hazardous and toxic waste management activities at PT XY.

Table 4. Risk Findings at PT XY

No.	Risk
R.1	Changes in ambient air quality and increased dust levels caused by - loading and unloading activities of hazardous and toxic waste - mobilization of vehicles transporting hazardous and toxic waste - emission of exhaust gases from the combustion of incinerators and exhaust gases of vehicles
R.2	Increased noise intensity caused by loading and unloading activities and vehicles transporting hazardous and toxic waste
R.3	Decrease in the quality of soil fertility originating from seepage of the oil catcher
R.4	The generation of solid and liquid hazardous and toxic waste originating from the operational stage of the activity



R.5	Forklift overturns when carrying out activities to move drums containing hazardous and toxic waste
R.6	There are no instructions for use on machines that produce a high risk
R.7	The work area is not barrier-free - Installation of piping that is still above ground level - The work paths in the processing of hazardous and toxic waste are not yet free from obstacles
R.8	Hazardous and toxic waste transported from the producer exceeds the capacity of the storage container
R.9	The occurrence of fires due to the reaction of hazardous and toxic waste materials stored with flammable characteristics
R.10	The lighting in the warehouse for storing hazardous and toxic waste is not optimal, which can interfere with the concentration and vision of workers
R.11	Lack of ventilation in hazardous and toxic waste treatment areas
R.12	The hazardous and toxic waste treatment room only has one primary access as an entry-exit way
R.13	There are no signs or warnings for work areas that require personal protective equipment
R.14	Direct contamination of hazardous and toxic waste on workers' bodies due to waste handling activities carried out without using special personal protective equipment
R.15	The design of the stairs in the hazardous and toxic waste treatment area is not ergonomic
R.16	There are no unique signs around the machine that produce high temperatures
R.17	Work accident - Activities of loading and unloading of hazardous and toxic waste materials that tend to be unsafe - Attitude of employees who ignore safety aspects at work - Carry out activities that are not by the Standard Operating Procedures (SOP) that have been made - Negligence of workers due to the absence of instructions for use on specific machines
R.18	Health problems originating from decreased air quality, noise, waste generation, drainage channels, wastewater, and hazardous and toxic waste generation

2. Risk Assessment

After identifying the risk, the next step is to conduct a risk assessment. Risk assessment aims to determine how significant the risk value is and determine which activities have the potential for extreme, high, medium, and low risks. The researcher carried the risk assessment with the company's risk management coordinator (occupational safety and health expert).



Table 5. Risk Assessment at PT XY

No.	Severity		Likelihood		Relatif Risk (S x L)	Risk Level
	Value	Category	Value	Category		
R.1	3	Moderate	4	Likely	12	High Risk
R.2	3	Moderate	4	Likely	12	High Risk
R.3	4	Major	4	Likely	16	Extreme Risk
R.4	3	Moderate	3	Possible	9	High Risk
R.5	2	Minor	3	Possible	6	Moderate Risk
R.6	4	Major	4	Likely	16	Extreme Risk
R.7	2	Minor	4	Likely	8	High Risk
R.8	3	Moderate	4	Likely	12	High Risk
R.9	5	Bencana	3	Possible	15	Extreme Risk
R.10	2	Minor	4	Likely	8	High Risk
R.11	3	Moderate	4	Likely	12	High Risk
R.12	4	Major	3	Possible	12	High Risk
R.13	3	Moderate	3	Possible	9	High Risk
R.14	4	Major	3	Possible	12	High Risk
R.15	3	Moderate	3	Possible	9	High Risk
R.16	4	Major	3	Possible	12	High Risk
R.17	4	Major	3	Possible	12	High Risk
R.18	4	Major	3	Possible	12	High Risk

3. Risk Evaluation

Based on data collection through observations of hazardous and toxic waste management activities at PT XY, the highest risk results were seen at the high-risk level of 14 risks (R1, R2, R4, R7, R8, R10, R11, R12, R13, R14, R15, R16, R17, R18), followed by the finding of extreme risk with the number of findings of 3 risks (R3, R6, R15), and the extreme risk level with the number of findings of 1 (R5). From the description of the three levels of risk at PT. XY, which can lead to opportunities for accidents and even losses, the researcher proposes actions made to reduce and control every risk that exists in PT XY.

Table 6. Proposed Actions for Risk Control

No.	Proposed Actions for Risk Control
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- | | |
|-----|---|
| R.1 | - Carry out reforestation activities around the activity location to minimize the influence of dust and create a beautiful work environment
- Advise workers to use dust mask when carrying out activities that have the potential to be exposed to dust, especially during loading and unloading activities, considering that what is being unloaded is hazardous and toxic waste |
| R.2 | - If possible, when the loading and unloading process is carried out, the vehicle engine is better turned off
- Require employees to use standard earplugs, especially if the noise level is higher than the required limit
- Limitation of the length of time workers are exposed to noise based on the maximum length of work allowed according to the noise intensity |
| R.3 | - Periodically check the condition of the oil catcher reservoir
- Ensure that the oil catcher is always in a leak-proof condition and is closed when it rains |
| R.4 | - Replacing hazardous and toxic waste packaging that is not suitable for use with better packaging is done to avoid spilling or spilling when transporting hazardous and toxic waste is carried out
- Separating waste according to waste categories and characteristics |
| R.5 | - Workers who carry out activities using forklift vehicles must be equipped with personal protective equipment in helmets, gloves, safety shoes, and clothing.
- Installation of machine guarding when the forklift is operating
- Creating forklift ramp layouts |
| R.6 | - Installation of signs is prohibited from crossing the machine area except for officers
- Conduct regular checks on the machines used in operational activities
- Providing training and competency improvement for workers who are directly related to machines for operational activities |
| R.7 | - Provision of unique mobility lane signs
- Installation of signs is prohibited from crossing the piping area except for officers
- Making the design of the work environment safer by applying the 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke) principle |
| R.8 | Placing a base in the form of a tarp or used cardboard over spills or spills of hazardous and toxic waste before any cleaning activities using sawdust |
| R.9 | - Installing fire alarms and fire extinguishing systems in the warehouse area for storing hazardous and toxic waste
- Build a hydrant as a fire protection device |
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- R.10 - When using natural lighting, care must be taken so that the passage of light is not blocked
- Maintain the cleanliness of walls, ceilings, floors, lamps, and equipment. Maintenance must be done regularly because dirt and dust can reduce the intensity of lighting by up to 35%
-
- R.11 - Increase ventilation in the work area that produces high temperatures
- Use of comfortable and loose work clothes
 - Perform manual dust cleaning by sweeping, shoveling, and throwing it into the shelter if possible to catch dust with a dust collector
-
- R.12 Adding 1 (one) access in and out of the hazardous and toxic waste treatment area that is open and out
-
- R.13 Procurement of work safety signs and signs for using personal protective equipment in the work area and installing them in an easily visible place
-
- R.14 - Providing training on proper work methods when handling hazardous and toxic waste and the use of correct prevention measures
- Provide personal protective equipment related to waste management such as work clothes, safety shoes, leather gloves, rubber gloves, masks
-
- R.15 Redesign the stairs by taking into account the safety aspects of users
-
- R.16 Controlling the air temperature and humidity of the room in the incinerator operational area as well as regulating machine working and rest hours
-
- R.17 Conduct regular occupational safety and health inspections, including inspection of the work environment, materials, equipment, and systems, socialization of personal protective equipment with firm action to workers, consistent use of PPE such as masks, gloves, glasses, earplugs, and shoes
-
- R.18 - Improved health through health promotion
- Early diagnosis and prompt treatment as well as limiting weak points to prevent complications
-

Based on data collection through observation, PT XY found the results, and the highest risk findings were at high-risk levels. Three factors are moving in a single chain that can affect the amount of risk in the workplace, namely the environment, work, and people (Ariani, 2016). This statement is in line with the data from observations made by researchers. In addition to the conditions of the work environment, other supporting factors can determine the level of risk that exists in PT. Work to losses for the company—the majority of workers at PT. XY has a less disciplined work attitude, which needs to be investigated more deeply about what factors influence it. Thus, it can be considered whether it is true that poor work attitudes are caused by destructive perceptions, lack of knowledge, and lack of compliance among workers (Darmawan *et al.*, 2017).



According to the researcher, most of the workers at PT. XY has work attitudes that are not by occupational safety and health, while the indicators of work attitude of workers at PT. XY looks less good, such as (Pratama, 2015):

1. Unsafe Action

There are many causes of unsafe work actions, including weak supervision, absence of a leader, poor work standards, or weaknesses in management functions.

2. Unsafe Conditions

It comes from the work environment, whether from tools, materials, or an unsafe and dangerous environment, such as a lack of lighting at work.

3. Lack of knowledge of workers about workplace conditions can negatively impact the workers themselves. Lack of knowledge is caused by lack of experience, inadequate orientation, or poorly understood training.

4. Skills

Good worker skills reflect efficient coordination between the mind, the function of the senses, and the body's muscles.

5. Job training

Training for workers is an integral part of the hazard control program as part of the workplace's occupational safety and health program. If workers are not trained, there is a high possibility of accidents at work.

6. Working Standard

Standard operating procedure must contain detailed work processes from the beginning to the final stage of the work. The existence of an standard operating procedure is significant because it functions as reference material and a list of a worker's activities when using work tools or carrying out their duties at work.

Factors related to the level of risk in PT XY occurs interrelated between the complex nature of work, workplace conditions, and human behavior. Most of the problems are that workers tend to underestimate long-standing risks such as chemical contamination and an indifferent attitude towards occupational safety and health by not wearing complete personal protective equipment when working, so these two things need to be controlled (Sulaiman *et al.*, 2019).

Conclusion and Recommendation

It can be concluded that the risk has the highest risk value at PT XY is the risk of fire in the storage area due to the reaction of stored hazardous and toxic waste, while the risk with the lowest value is the risk of the forklift overturning when carrying out drum transfer activities. - The drum contains hazardous and toxic waste materials. The overall risk findings impact the ongoing management of hazardous and toxic waste at PT XY. However, this can be overcome by proper



risk management, tightening supervision, and control to reduce the risk value to the lowest level. Other researchers can develop different types of methods and variables in discussing risk management studies to get better results.

References

- Ariani, A. R. (2016). *Hazard Identification and Risk Assessment (HIRA) Sebagai Upaya Mengurangi Risiko Kecelakaan Kerja dan Risiko Penyakit Akibat Kerja di Bagian Produksi PT. Iskandar Indah Printing Textile Surakarta*. Universitas Muhammadiyah Surakarta. Available at: <http://eprints.ums.ac.id/id/eprint/46958>
- Australian Standard/New Zealand. (2004). *Handbook Risk Management Guidelines companion to AS/NZS 4360 :2004*. Sydney and Wellington
- Badan Pusat Statistik Kota Batam (2019) *Jumlah Perusahaan dan Tenaga Kerja Sektor Insuari Pengolahan 2018-2019*, Badan Pusat Statistik. Kota Batam
- Darmawan, R., Ummi, N., Umyati, A. (2017). 'Identifikasi Risiko Kecelakaan Kerja Dengan Metode Hazard Identification and Risk Assessment (HIRA) di Area Batching Plant PT XYZ', 5(3), pp. 308–313
- Dinas Lingkungan Hidup Kota Batam. (2020). *Laporan Pengawasan Lingkungan Hidup Kota Batam Untuk Sektor Pengelolaan Limbah Industri Tahun 2019*. Kota Batam
- Fajriyah, S. A. and Wardhani, E. (2020). Evaluasi Pengelolaan Limbah Bahan Berbahaya dan Beracun (B3) di PT.X, *Jurnal Serambi Engineering*, 5(1), pp. 711–719. doi: <http://dx.doi.org/10.32672/jse.v5i1.1597>
- Hameed, H. B., Ali, Y. and Petrillo, A. (2020). Environmental risk assessment of E-waste in developing countries by using the modified-SIRA method', *Science of the Total Environment*. Elsevier B.V., 733. doi: 10.1016/j.scitotenv.2020.138525
- Indragiri, S. (2018). Manajemen Risiko K3 Menggunakan Hazard Identification Risk Assessment and Risk Control (HIRARC), *Jurnal Kesehatan*, 9(1), pp. 39–52. doi: <http://dx.doi.org/10.38165/jk>



- Kurniawan, B. (2019). Pengawasan Pengelolaan Limbah Bahan Berbahaya dan Beracun (B3) di Indonesia dan Tantangannya, *Jurnal Dinamika Governance*, 9(1), pp. 39–49
- Nasir, M. and Saputro, E. P. (2015), Manajemen Pengelolaan Limbah Industri, *Jurnal Manajemen dan Bisnis*, 19(5), pp. 143–149
- Norini and Afrzal. (2017). Peran Badan Lingkungan Hidup Provinsi Kepulauan Riau Dalam Perlindungan dan Pengelolaan Lingkungan Hidup Terhadap Limbah B3 di Kota Batam, *Jurnal Ilmu Pemerintahan*, 1(2), pp. 153–165
- Nurlani, M. (2019). Pengelolaan Lingkungan Hidup Akibat Limbah Industri Ditinjau Dari Sektor Hukum, Ekonomi, Sosial dan Budaya di Indonesia, *Jurnal Thengkyang*, 2(1), pp. 64–84
- Pemerintah Indonesia. (2021). *Peraturan Pemerintah Nomor 22 Tahun 2021 tentang Penyelenggaraan Perlindungan dan Pengelolaan Lingkungan Hidup*. Indonesia
- Pratama, A. K. (2015). Hubungan Karakteristik Pekerja dengan *Unsafe Action* pada Tenaga Kerja Bongkar Muat di PT.Terminal Petikemas Surabaya, *Jurnal Keselamatan dan Kesehatan Kerja*, 4(1). doi: <http://dx.doi.org/10.20473/ijosh.v4i1.2015.64-73>
- PT XY. (2020). *Profile PT. XY*. Batam.
- Sari, I. D. M. (2018). Pengelolaan Limbah Industri PT. Apac Inti Corpora Bawen Semarang, *Jurnal Cakrawala Hukum*, 9(2), pp. 186–194. doi: <https://doi.org/10.26905/idjch.v9i2.2773>
- Sijabat, C. B. and Sunday, N. (2014). Application of Hira and Spar-H Method To Control Work Accident, *Jurnal Teknik Industri*, 15(1), p.70. doi: 10.22219/jtiumm.vol15.no1.70-79
- Sulaiman, F. *et al.* (2019). Rancangan Penilaian Risiko Limbah Bahan Berbahaya dan Beracun (B3) dengan Pendekatan *Hazard Identification Risk Assessment* (HIRA), *Jurnal Teknik Mesin Untirta*, 5(2), pp. 44–50. doi: <http://dx.doi.org/10.36055/fwl.v1i1.6446>