Journal of Research in Social Science And Humanities (2025); 5(1):
DOI: http://dx.doi.org/10.47679/jrssh.v5i1.363
ISSN 2809-3356 (print), ISSN 2807-3916 (online)

RESEARCH ARTICLE

Optimization of Non-Hazardous and Toxic Waste (B3) Management from Airside Aircraft Operations: A Case Study of Adi Soemarmo Airport

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Published online: 25 Ffebruary 2025

Abstract

Adi Soemarmo Airport serves domestic and international flights that generate waste from airport operations and aircraft operations. One waste storage site (TPS) is provided. The establishment of the TPS is specifically to manage waste from airport operations, this is based on the Letter of Coordination Agreement (LOCA) which states that the waste from aircraft operations is managed by the ground handling party. However, in its daily activities, there is still scattered and piled up waste in the airport airside area which is dominated by non-hazardous and toxic waste. Therefore, this study aims to find efforts to optimize the management of non-hazardous and toxic waste from aircraft operations at Adi Soemarmo Airport. This research uses descriptive qualitative research methods and data collection techniques using observation for four months, interviews with three informants, and accompanied by documentation. The results of this study obtained four optimal efforts that can be done, namely evaluating the LOCA between ground handling and PT Angkasa Pura I, socializing the importance of airside area cleanliness, making written SOPs, and providing special facilities for aircraft waste. The results are expected to be used by other researchers to optimize the management of waste from aircraft operations in the airport airside area so as to realize an airside area that is free from everything that has the potential to cause events and accidents

Keyword: Optimization of non-hazardous and toxic waste management, airside area, ground handling, Apron Movement Control

Introduction

Air transportation or air transportation on the island of Java in particular and in Indonesia in general, has an important role in people's lives. With air transportation, people will be more helped because air transportation is more effective and efficient to enter areas that are difficult to visit using other transportation, both in the economic, social, governmental, tourism, and so on fields (Fachrudin et al., 2024) Currently, technology in air transportation is increasingly developing in line with the aviation industry in Indonesia which is also increasingly in demand by the public (Aulia, 2023). As we know, air transportation always begins and ends at the airport, making the airport must have facilities and infrastructure that support the sustainability of flight activities. One of the airports on the island of Java is Adi Soemarmo Airport which is right in Ngemplak District, Boyolali, Central Java. This city is one of the airports managed by PT Angkasa Pura I.

Adi Soemarmo Airport is still actively serving domestic and international flights to this day. Every day there are approximately 12 scheduled domestic flights that arrive and depart from and to Adi Soemermo Airport. With flight activities, it will certainly produce an effect, one of which is the generation of waste. The waste at this airport comes from the results of aircraft operations and airport operations. In accordance with the Regulation of the Minister of Transportation Number PM 54 of 2017 in Chapter IV concerning the Provision of Waste and Chemical Substance Shelters in Article 6 Paragraph 2 which reads that "Airport operators are obliged to provide airport TPS in accordance with the scale of waste produced at the airport", the manager of Adi Soemarmo Airport has provided a special Temporary Shelter (TPS) to manage waste from airport operations. Meanwhile, waste from aircraft operations is managed by the ground handling.

From this, the researcher saw that there was a pile of garbage from the results of aircraft operations in the airside area, precisely in the parking lot of the eastern ground support equipment (GSE) vehicle by the ground handling party, especially during the Hajj flight from Adi Soemarmo Airport. On ordinary days when researchers together with movement control apron (AMC) officers conduct apron cleanliness inspections, garbage can still be seen scattered in the airside area, including in the drainage and on top of unused GSE vehicles covered with makeshift tarps. The condition of the airside area should ideally be clean from everything that is at risk of becoming foreign object debris (FOD) so that flight safety and security can be carried out properly (Fatimah & Fauziah, 2023) The accumulated waste is dominated by plastic waste and organic food waste (Peron & Mursyid, 2024).

This happened because the ground handling itself did not have a special place to store waste from aircraft operations before it was transported to the landfill. On the other hand, the ground handling has collaborated with vendors to manage their waste.

The situation regarding the accumulation of waste is also contained in the research researched by (Pambudi & Sutarwati, 2022) where the results of the research show that in the airside area of Sultan Hasanuddin International Airport Makassar there is a accumulation of garbage carried out by the ground handling. In the study, it is stated that there are several actions that can be taken, including routine patrols in accordance with the applicable SOPs and also actions taken in accordance with the regulations that have been enforced at the airport (Martin et al., 2022). The actions mentioned in this study are for those who violate the regulations that have been set, the airport pass will be revoked and the apron area will be cleaned (Putri & Hamzah, 2021).

The same thing also happened at Mopah Merauke International Airport, Papua as seen from previous research (Melani & others, 2023) shows that scattered objects and other objects can cause damage to the aircraft so that it can be dangerous in flight. So that solutions were obtained in the research, including by conducting inspections and identification related to the potential for hygiene problems caused by garbage and other foreign objects (Surahmah et

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al., 2024). Then with timely cleaning after landing. Finally, the solution that can be used is to provide education and training to relevant officers by the AMC regarding the importance of cleanliness of the airside area and correct cleaning procedures (Maemunah et al., 2022).

From the two incidents above, surveillance in the airside area is also very important to be carried out, especially related to cleanliness (Mafaza & Haryati, 2022). In his research, he explained that AMC, in addition to having the task of supervising all movements in the airside area, AMC officers also have the task of handling wild animals that interfere with workers' activities by means of hygiene inspections around the airside area so that no wild animals enter the area and prioritize cooperation between officers and with the results of this cooperation it is hoped that it can solve the problem (Dayyanu & Martanti, 2023).

Based on this background, the cleanliness of the airside area is very important to keep clear from all objects at risk of becoming FOD. The optimal management of waste in the airside area must continue to be improved with the best solutions to reduce the risk of incidents and flight accidents (Utomo, 2019). Supervision from AMC officers also plays a very important role in creating this situation. No less important is cooperation between related officers, which can also optimize and realize clear air areas from all objects at risk of becoming FOD. Therefore, the researcher is interested in conducting a research with the title "Optimization of Non-B3 Waste Management as a Result of Aircraft Operations in the Airside Area of Adi Soemarmo Airport".

Method

The This research was prepared using a qualitative type of research. The researcher obtained data from the results of field observations, interviews with informants, and documentation. This type of research is used to deeply understand the subject phenomenon through verbal descriptions (Tanujaya & others, 2017) Qualitative research aims to establish the focus of the research, select informants as data sources, collect and evaluate data, and then conclude the results of the research (Zebua et al., 2022) Based on this explanation, this study aims to understand more deeply about the management of non-B3 waste from the results of aircraft operations in the airside area of Adi Soemarmo Airport which is managed by the ground handling. Qualitative research is not only to look for cause and effect but to better understand specific situations (Al-Fahad et al., 2023).

2.1. Data Analysis Techniques

Research based on the philosophy of postpositivism to examine a scientific object is called qualitative (Waruwu & others, 2023). The researcher plays a key role in the data collection technique by combining them, inductive/qualitative properties in data analysis, and the results of this study focus on generalizations (Sita, 2017). This study uses descriptive qualitative data analysis techniques, by describing the results of the research with systematic sentences to clearly describe the results of the research [14].

The overview of the flow of qualitative research data analysis according to Huberman and Miles in 1984 which was reviewed (Rahmatika D, 2023). This study use that qualitative research data too which start with data collection then continue with data presentation after that data reduction and end it with conclusion

Data collection through field records. Field notes are notes written when researchers see, hear, and experience an event when conducting qualitative research (Suparman et al., 2024). Field records have 2 types, namely descriptive and reflective (Kurniawati et al., 2023). The data collected by the researcher was obtained by conducting observations for four months directly in the airside area of Adi Soemarmo Airport, interviews were conducted face-to-face with the three informants that the researcher had previously mentioned, and documentation obtained by the researcher from airport archive documents, photos taken directly by the researcher and from previous journals, which were subsequently processed in accordance with applicable regulations.

Furthermore, data reduction is also called summarizing the main things, focusing on the prioritized, then looking for themes and patterns (Zebua et al., 2022). The data collected in large quantities is sorted and summarized by researchers according to the most relevant information and regulations. The data was obtained by the researcher from the results of direct field observations, interviews with informants, and documentation that the researcher had obtained. The data will be discussed by the researcher after the researcher conducts the research.

Data presentation can be displayed as a brief description, flowchart, chart, relationship between categories and so on in qualitative research methods (Waruwu & others, 2023) The presentation of data can make it easier for researchers to develop research. (Ayen et al., 2016) The data that the researcher has obtained, the researcher will present in the form of a description (Tambusai, 2021).

After the presentation of the next data, the conclusion given is non-permanent, it can be replaced if there is no supporting evidence in the next data collection process. The evidence that strengthens the conclusion is called verification (Nida et al., 2023). [21] The researcher obtained this verification through observation checklists, interview records, and researcher documentation checklists included in the appendix to this study.

2.2. Subject

The subject of the study has information and plays an important role in a research [22]. In this study, the researcher selected the subject of the study from three responsible units, namely:

Table 1 Subject of the Study

No.	Name	Unit	Job Position
1	Endang	Ground Handling	Internal Supervisor
2	Dimas	AMC	Supervisor
3	Zaim	Airport Safety Risk and Performance	Officer

Disscussion

Researchers have made these observations from October 2023 to January 2024. In accordance with the research grid, the researcher made observations in the aspect of cleanliness of the airside area and supporting facilities related to cleanliness at Adi Soemarmo Airport. Observations were recorded and documented directly by the researcher accompanied by one of the AMC personnel and supported by the Airport Operation Airside unit and the Airport Safety, Risk and Performance unit with the aim of finding solutions related to the problem. From these observations, it was found that Adi Soemarmo Airport had provided one polling station. This is in accordance with PM 54 of 2017 which stipulates that each airport is obliged to provide a TPS according to the scale of waste produced at the airport. This polling station is located to the east of the airport. However, this TPS only accepts waste from the results of airport operations, where the ground handling party has its own system in managing its waste.

Garbage from aircraft operations looks scattered and there is also garbage collected at the FOD disposal site in the airside area which should not be a garbage can from aircraft operations. In addition, garbage from aircraft operations is also piled up in the GSE parking area. After being collected and stacked, the ground handling officers in the field piled up into one on an empty land opposite the GSE parking lot west of the airport as shown in figure below.

During the observation, researchers more often found the findings of accumulation and scattering of garbage on Tuesday to Sunday, while on Monday the area on the air side tended to be cleaner and there were no such findings. In contrast to TPS which manages waste from the results of airport operations, cleanliness and waste

Figure 1 ***Ground handling piles of garbage***

management tend to be more optimal and it is rare to find scattered garbage.

In this study, the researcher conducted interviews with three form of direct questions and answers to one AMC unit supervisor, one Ground Handling internal supervisor, and one Airport Safety, Risk and Performance Management unit personnel.

At the beginning of the interview, the researcher asked the first question, namely "Do you think the cleanliness of the airside area at this airport is optimal?" from the question, the three informants who do have their own duties in terms of waste management in the airside area explained that the cleanliness in the airside area has not been well managed because there is still a lot of garbage scattered and piles of garbage when there is a Hajj flight. Informant 1 explained that there had never been an incident that caused an accident caused by garbage. It is different with informants 2 and 3 who stated that there is still a lot of garbage scattered in the airside area which is feared to cause incidents and accidents on flights.

The second question that the researcher asked was "What garbage exists from the results of aircraft operations or in the airside area?". Informant 3 explained "Non-B3 waste. Food waste provided by the airline for passengers. There is also food and beverage wrapping waste for ground handling officers every day". In line with informant 3, another informant also confirmed the same thing. After knowing that waste management in the airside area is not optimal and the type of waste that exists, the researcher asked the third question, namely "Does Ground Handling have a special policy in managing non-B3 waste from the results of aircraft operations in writing that is also known to PT Angkasa Pura I?" Informant 1 who does occupy the position of Supervisor of Internal Ground Handling explained that "Every day we use literature that we usually do. To be written, until now from our side and the airline, there are no written rules or written procedures." this was also agreed by informant 3. Then from informant 2 briefly explained the procedures for waste management that have been used, namely by collecting and then piling up after which it is transported by a third party from ground handling.

Furthermore, the researcher asked the fourth question, namely "Is there a special policy between Ground Handling and PT Angkasa Pura I related to waste management?" then from the three informants answered that there is a coordination agreement called LOCA between ground handling and PT Angkasa Pura I regarding international aviation waste management. Because the agreement only regulates the management of waste from international flights, the researcher again asked the fifth question, namely "Does the existence of this policy hinder the management of daily aircraft waste?" from informant 3 explained, "It is different from domestic waste management. So there should be a separate policy for domestic waste." Then informant 1 explained that "It does not hinder. But for domestic waste management, the agreement only mentions that we manage it ourselves." Then it is supported by a statement from informant 2, namely "In my opinion, it is not an obstacle but indeed has no effect on domestic waste management." so it can be concluded that the existence of LOCA does not hinder because the policy in LOCA is not for domestic flights.

After knowing the existence of the agreement, the author asked about the shortcomings of the agreement with the sixth question, namely "What are the shortcomings of the existing policy?" where informant 1 explained that the shortcomings of the LOCA did not explain the management of waste from the operation of domestic aviation aircraft, only focusing on waste management from the operation of international aviation aircraft. Informant 2 and informant 3 stated that the shortcomings of LOCA did not include the procedures for waste management in writing, which made waste management inoptimal from waste management both from domestic and international flights.

Then the researcher asked about the existing TPS facilities but did not receive waste from the results of aircraft operations by asking the seventh question, namely "Until now there is no special TPS for aircraft waste, so how does the ground handling manage the waste before it is transported by a third party?" informant 1 explained that "We use the system in general. We collect it in plastic waste and then we tie it and we stack it into one and then transport it by a third party.". Meanwhile, from informant 2 explained that "The management carried out by ground handling is by collecting, then if a little is brought to the GSE parking lot, if a lot is piled up in the vacant land behind the west GSE parking lot, sometimes if it has not been transported they cover it with a tarpaulin." And from informant 3 explained that "I see that it is always stacked on the vacant land to the west, yes, but sometimes during the inspection I find it stacked in the GSE parking lot or in the GSE vehicle that is no longer used and then closed so that it does not rain or fly". So it can be concluded that waste management carried out by ground handling is by collecting from airplanes using plastic waste and piling it up in certain places and then closing it so that it is not exposed to rain or flying.

At the end of the interview session, the researcher asked the expectations of the three informants related to optimization Especially for waste from aircraft operations in the airside area with the eighth question, namely "What are your expectations in optimizing waste, especially for waste from aircraft operations in the airside area?" Informant 1 hopes that it will be better managed and that there are systems or policies and facilities that make it easier for implementers in the field to manage the waste. Informant 2 hopes that there will be an improvement in waste management, so that there is no more scattered waste that can be at risk of becoming FOD if the waste enters the apron. Meanwhile, informant 3 hopes that there will be the best solution so that there is no more accumulated garbage that is at risk of becoming FOD and damaging aesthetics, it can be with a re-agreement or other policies later. From these expectations, it can be concluded that with better policies in the form of agreements or other written procedures and also with the existence of other supporting facilities provided, it is hoped that it can be more optimal in waste management.

From the results of the documentation carried out by the researcher, the waste management procedures that ground handling applies daily are unwritten procedures. The ground handling takes and collects waste from aircraft using plastic waste manually, then it is stockpiled and will be picked up by the vendor every two to three days. This procedure is commonly used by all ground handling at Adi Soemarmo Airport. The researcher also obtained documentation from the documentation archive of the Airport Safety, Risk and Performance Management unit, one of which was an incident in July 2023 and can be seen in figure IV.2 below. The accumulation of garbage is the garbage resulting from the Hajj flight. The waste is managed in accordance with the existing LOCA, but it looks not optimal even though it is based on the existence of the LOCA.

Figure 2 ***Accumulation of garbage in the parking lot of the east GSE***

Supported by the Ramp Safety Campaign activities, researchers found that the accumulation of garbage and scattered garbage findings so that it is at risk of becoming FOD increased from July 2023 to August 2023.

Based on the results of the research that has been analyzed by researchers, it was found that the management of non-B3 waste in the airside area of Adi Soemarmo Airport has been carried out in accordance with applicable regulations and agreements agreed by both parties, but the management is still not optimal because there are still many findings in the airside area.

Therefore, the researcher obtained several actions that can be taken to optimize the management of non-B3 waste from aircraft operations in the airside area of Adi Soemarmo Airport. Actions that can be taken include:

(1) Evaluating LOCA between Ground Handling and PT. Angkasa Pura I. From the results of this study, the existing LOCA does not mention how the waste management system is. In fact, the ground handling party transports waste to third parties every 3-4 days. Before the transportation is carried out, the ground handling parties will collect and store the waste. That is what made the researcher initiate a solution with the importance of holding an evaluation

related to the waste management operational coordination agreement or LOCA.

(2) Socialization of the Importance of Cleanliness of the Air Side AreaThe cleanliness of this airside area is the responsibility of all parties involved in the area to avoid bad risks that may occur. Socialization with the aim of providing education and training related to the cleanliness of the airside area to related parties can provide understanding so that it can create the desired condition of the airside area (Mutiarani & Masyi'ah, 2023).

(3) SOPs. This written SOP, in which it is necessary to include the flow of waste management with the period of transporting waste to third parties, how to collect waste and its waste storage areas as well as the waste transportation vehicles used This SOP needs to be known by all related parties, namely AMC personnel and Airport Safety, Risk and Performance Management as supervisors, airlines and ground handling as managers.

(4) Provision of special facilities for aircraft waste. The facilities that are already available at this airport are TPS located on the east side of the airport. However, this TPS only accepts waste from airport operations. Meanwhile, the waste from the aircraft was handed over to the ground handling. From the results of the study, it was found that there was no special place for the ground handling to pile up their garbage, which was one of the factors that did not realize the cleanliness of the airside area.

There is a vacant land behind the west GSE parking lot and outside the airport parimeter boundary. This vacant land is adjacent to the old airport building that is no longer in use and also opposite the land owned by local residents. It is the location that makes the land abandoned. The location of the vacant land is exactly as seen in figure IV.4. The vacant land is still abandoned and left alone. The establishment of facilities on this vacant land is expected to make the vacant land more useful.

Figure 3 **Vacant land behind the west GSE parking lot**

The researcher recommends the establishment of this facility with criteria in accordance with PM 54 of 2017 concerning Waste Management and Chemical Substances for Aircraft and Airport Operations in article 6 which states that the criteria for TPS at the airport must be in an easily accessible location, the placement does not interfere with operations and damages aesthetics, has an area that is in accordance with needs,

Therefore, the researcher gave suggestions for the design of the building as shown below

Figure 4 ***Non-B3 waste storage building***

Optimization efforts with the availability of this facility are in accordance with research conducted by [3] which states that the surveillance of the airside area will run smoothly if the availability of adequate facilities is good.

With better regulations or SOPs, socialization about the dangers that can be caused, and with the supporting facilities provided. can help realize non-B3 waste management from the results of aircraft operations in the optimal airside area of Adi Soemarmo Airport

Conclusions and Recommendations

Adi Soemarmo Airport already has a good waste management system as a result of airport operations, but the management of waste from aircraft in the airside area still looks less than optimal. This can be seen in daily activities, there are still many conditions in the airside area that are not ideal or there are still many scattered garbage. Optimizing the management of non-B3 waste as a result of aircraft operations at Adi Soemarmo Airport can be done by reviewing existing agreements, socialization related to the importance of cleanliness of the air side, written SOPs on waste management procedures, and supporting facilities provided. The optimal waste management can minimize the risk of incidents and accidents at Adi Soemarmo Airport. With the solution that the researcher has previously initiated, it is expected to be able to optimize the management of non-B3 waste from aircraft operations in the airside area of Adi Soemarmo Airport).

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