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# Analysis of the Manoeuvring of MV Aquagenie 1 during Anchoring at Yeosu Anchorage

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**ABSTRACT**

Anchoring in open and congested anchorages exposes ships to operational risks, particularly when weather, current, and wind conditions change rapidly. This study analyses the manoeuvring of MV Aquagenie 1 during anchoring at Yeosu Anchorage, South Korea, and evaluates the factors that caused the anchor dragging incident that occurred there. A descriptive qualitative design was used, with data collected through direct observation on board, in-depth interviews with the Master, the Chief, Second, and Third Officers, and a helmsman, and analysis of the ship's operational documents. On 25 July 2023, the ship anchored in the outer anchorage (D-1) without a pilot, paying out six shackles of anchor chain (about 165 m) in initially good weather. The weather then deteriorated sharply, with wind speeds reaching about 35 knots, and the anchor could no longer hold the ship, which began to drag. The analysis identified three internal factors, namely an anchoring position that did not account for the risk of bad weather and the type of seabed, an insufficient length of chain for the conditions, and ineffective anchor watchkeeping as the weather worsened, together with two external factors, namely strong wind and waves and a sandy mud seabed. To prevent similar incidents, the study recommends specific training for the crew, adjustment of the chain length to the water depth and the weather forecast, closer coordination and monitoring during the anchor watch, and routine inspection of the anchoring equipment.

***Keywords:*** Ship Manoeuvring, Anchor Dragging, Yeosu Anchorage, Navigation Safety, MV Aquagenie 1

**ABSTRAK**

Berlabuh jangkar di area labuh yang terbuka dan padat menghadapkan kapal pada risiko operasional, terutama ketika kondisi cuaca, arus, dan angin berubah dengan cepat. Penelitian ini menganalisis olah gerak kapal MV Aquagenie 1 saat berlabuh jangkar di Yeosu Anchorage, Korea Selatan, serta mengevaluasi faktor-faktor penyebab insiden jangkar larat yang terjadi. Penelitian menggunakan metode deskriptif kualitatif dengan pengumpulan data melalui observasi langsung di kapal, wawancara mendalam dengan Nakhoda, Mualim I, II, III, dan juru mudi, serta analisis dokumen operasional kapal. Pada 25 Juli 2023, kapal berlabuh di outer anchorage (D-1) tanpa bantuan pandu dengan menurunkan enam segel rantai jangkar (sekitar 165 m) dalam kondisi cuaca awal yang baik. Cuaca kemudian memburuk secara drastis dengan kecepatan angin mencapai sekitar 35 knot, sehingga jangkar tidak mampu lagi menahan kapal dan kapal mengalami larat. Hasil analisis mengidentifikasi tiga faktor internal, yaitu posisi labuh yang tidak memperhitungkan risiko cuaca buruk dan jenis dasar laut, panjang rantai yang tidak memadai untuk kondisi tersebut, serta dinas jaga labuh yang tidak efektif saat cuaca memburuk, ditambah dua faktor eksternal, yaitu angin kencang dan gelombang serta dasar laut lumpur berpasir. Untuk mencegah kejadian serupa, penelitian ini merekomendasikan pelatihan khusus bagi awak kapal, penyesuaian panjang rantai

dengan kedalaman perairan dan prakiraan cuaca, peningkatan koordinasi dan pemantauan selama dinas jaga labuh, serta pemeriksaan rutin peralatan jangkar.

**Kata Kunci**: Olah Gerak Kapal, Jangkar Larat, Yeosu Anchorage, Keselamatan Pelayaran, MV Aquagenie 1

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## 1. INTRODUCTION

Sea transport is an important mode of transport that contributes greatly to the global economy, but shipping faces various technical and environmental challenges, particularly when ships anchor in open waters. Anchoring is an essential activity that keeps a ship in position so that it does not drift under the action of current and wind (House, 2014). Errors or negligence during anchoring can lead to a high risk of accidents, and human error has been identified as a major contributor to accidents that occur while anchoring and manoeuvring in anchorages (Rutkowski, 2019).

Yeosu Anchorage, located in South Korean waters, is a busy anchorage used by many merchant ships. Environmental conditions in this area can change quickly because of variable weather, currents, and winds. Studies of Korean open-sea anchorages have shown that anchored ships face significant risks in rough seas and that anchorage safety needs to be evaluated systematically (Kim & Gug, 2015; Lee et al., 2022). Effective and safe anchoring procedures are therefore necessary to avoid incidents such as anchor dragging, collision, or grounding.

National studies have analysed anchor dragging and anchor losses in Indonesian anchorages (Nugroho et al., 2019; Rafiudin et al., 2023) and the implementation of anchor watchkeeping in accordance with the STCW Convention (Rengga et al., 2024), but analyses of anchor dragging incidents involving

Indonesian crews in foreign anchorages remain scarce. This study was motivated by an incident in which MV Aquagenie 1 dragged its anchor at Yeosu Anchorage, South Korea. It aims to analyse the manoeuvring of the ship during anchoring, identify the causes of the incident, and formulate preventive measures to improve the safety of navigation and ship operations.

### 1.1. Factors Affecting Ship Behaviour at Anchor

The behaviour of an anchored ship is influenced by environmental factors, ship characteristics, and anchoring procedures. These factors determine the forces acting on the ship and the ability of the anchor and chain to resist them.

**a. Environmental conditions.** (1) *Current*: the speed and direction of the current exert a drag force on the hull and the anchor chain, causing the ship to move or change position (Faltinsen, 1990). (2) *Wind*: the strength and direction of the wind exert pressure on the hull and superstructure, producing lateral forces and yawing moments that can cause the ship to swing or shift (Faltinsen, 1990; Rawson & Tupper, 2001). (3) *Waves*: wave height and period cause the ship to roll, pitch, and heave, which also affects the tension in the anchor chain (Newman, 1977). (4) *Water depth*: the depth determines the length of chain required and the angle of the chain to the seabed, which in turn affects the holding ability of the anchor (Oil Companies International Marine Forum [OCIMF], 2008). (5) *Type of seabed*: the seabed material, such as sand, mud, or rock, determines the holding power of the anchor, and poor holding ground can cause the anchor to drag (Zhuang et al., 2021; Min & Oh, 2024).

**b. Ship characteristics.** (1) *Size and hull form*: larger ships with a greater windage area are more susceptible to wind and current (Rawson & Tupper, 2001). (2) *Anchoring system*: the type, size, and number of anchors, as well as the length and condition of the chain, strongly affect the ability of the ship to remain in position (OCIMF, 2008). (3) *Loading condition*: the distribution of cargo affects the draught, the windage area, and the response of the ship to external forces (Rawson & Tupper, 2001).

**c. Anchoring procedures.** (1) *Length of chain*: an insufficient length of chain causes a high pulling angle on the anchor, which reduces its holding power (Gard AS & DNV GL, 2016). (2) *Anchoring technique*: the way the anchor is let go and the chain is laid out affects the final position of the ship and the security of its hold

(House, 2014). (3) *Anchor watch*: the officer of the watch must continuously monitor the ship's position, the weather, and the anchor during the anchor watch (International Maritime Organization [IMO], 2011).

## 2. METHOD

This study used a descriptive qualitative method. Data were collected through direct observation on board MV Aquagenie 1, in-depth interviews with the Master, the Chief Officer, the Second Officer, the Third Officer, and a helmsman, and analysis of the ship's operational documents during the study period. The respondents are identified only by their rank. The data were analysed by grouping the observation, interview, and document data, comparing these sources, and interpreting them to identify the main causes of the anchor dragging incident (Bryman, 2016). The causes were classified into internal and external factors and compared with the literature on anchoring and marine accidents.

## 3. RESULTS AND DISCUSSION

### 3.1. Chronology of the Incident

Anchor dragging occurs when the anchor fails to grip the seabed firmly, so that the ship moves uncontrollably even though the anchor has been let go. On 25 July 2023, MV Aquagenie 1 arrived at Yeosu, South Korea, and anchored in the outer anchorage (D-1) without the assistance of a pilot, paying out six shackles of chain. The weather was initially good but then deteriorated sharply, with wind speeds reaching about 35 knots, and the anchor could no longer hold the ship, which began to drag. The main data of the incident are summarised in Table 1.

**Table 1.** Data of the Anchor Dragging Incident of MV Aquagenie 1

| Item | Description |
|---|---|
| Date | 25 July 2023 |
| Location | Outer anchorage D-1, Yeosu, South Korea |
| Pilot | Not used |
| Chain paid out | 6 shackles (about 165 m; 1 shackle = 27.5 m) |
| Initial weather | Good |
| Weather during the incident | Strong wind of about 35 knots with high waves |
| Seabed | Sandy mud |
| Outcome | Anchor dragged; the ship shifted from its anchoring position |

### 3.2. Causes of the Anchor Dragging

The analysis of the observation, interview, and document data identified the internal and external factors summarised in Table 2.

**Table 2.** Factors Causing the Anchor Dragging of MV Aquagenie 1

| Type | Factor | Description |
|---|---|---|
| Internal | Suboptimal choice of anchoring position | The selected position did not take into account the risk of bad weather or the type of seabed. |
| Internal | Ineffective anchor watch | Negligence in monitoring the surroundings delayed the response to the emergency as the weather worsened. |
| Internal | Insufficient length of chain | Only six shackles were paid out, which was not enough for the extreme weather that occurred, so the anchor lost its optimum holding power. |
| External | Bad weather | Strong wind and high waves greatly reduced the holding power of the anchor, so the ship was easily carried away. |
| External | Seabed condition | The sandy mud seabed in the anchorage provided limited holding under these loads, so the anchor broke out easily. |

The potential consequences of anchor dragging and the situational conditions that increase its risk are summarised in Table 3. Preventing anchor dragging therefore requires careful planning, selection of a suitable anchoring position, use of appropriate equipment, correct procedures, and careful monitoring.

**Table 3.** Potential Consequences of Anchor Dragging and Aggravating Conditions

| Potential consequences | Aggravating conditions |
|---|---|
| Collision with other ships | Congested anchorage |
| Grounding | Prolonged bad weather |
| Damage to subsea infrastructure (cables, pipelines) | Abrupt changes in water depth |
| Environmental pollution | Poor visibility |
| Economic losses | Lack of information about the anchorage |
| Danger to the crew | |

### 3.3. Discussion

The incident on MV Aquagenie 1 resulted from a combination of internal and external factors, which is consistent with analyses showing that anchoring accidents rarely have a single cause and that human and organisational factors are usually involved (Rutkowski, 2019; Sanchez-Beaskoetxea et al., 2021). The choice of the outer anchorage without a pilot and without considering the weather risk reflects a planning weakness. Studies of open-sea anchorages in Korea have shown that anchored ships in exposed areas are vulnerable to rough seas and that the safety of an anchorage depends on environmental conditions and the anchoring position (Kim & Gug, 2015; Lee et al., 2022). Similar dragging problems were observed among ships anchored in Osaka Bay during strong typhoon winds (Wakabayashi et al., 2019).

The length of chain and the type of seabed directly determine the holding force available to the ship. Six shackles (about 165 m) may be sufficient in good weather but became inadequate when the wind reached about 35 knots. Analyses

of the holding force acting on anchored vessels and of anchor dragging trajectories show that holding capacity depends on the chain length, the anchor penetration, and the seabed soil (Zhuang et al., 2021; Min & Oh, 2024), and measurements with tension meters have been used to evaluate the holding power of anchors in practice (Kim et al., 2019). Guidance on anchor losses also emphasises that anchoring equipment has limited design capacity, so the scope of chain must be increased, or the ship must weigh anchor, as wind and current increase (Gard AS & DNV GL, 2016; House, 2014). Once an anchor drags, the ship can drift a considerable distance and threaten other ships and subsea infrastructure (Zhu et al., 2019).

Ineffective anchor watchkeeping delayed the response to the worsening weather. Human error, including inadequate lookout, poor situational awareness, and weak communication, is a recurring factor in navigational accidents (Weng et al., 2019; Youn et al., 2019; Kasyk et al., 2023). The STCW Convention requires the officer of the watch at anchor to determine and plot the ship's position frequently, observe the weather and sea state, and ensure that the main engine and steering gear are ready when required (IMO, 2011). National studies likewise show that strict implementation of anchor watch procedures is essential to prevent anchor dragging (Rafiudin et al., 2023; Rengga et al., 2024). Modern methods for defining the anchoring area and detecting the anchor position can further support the watchkeeper in recognising dragging early (Cao et al., 2022; Cui et al., 2024).

Based on these findings, the following measures are recommended. (1) *Crew training*: in-depth knowledge of anchoring procedures should be developed through continuous training (House, 2014). (2) *Length of chain*: the length of chain should be adjusted to the water depth and the weather forecast at the anchorage, and the ship should be ready to pay out more chain, use the engine, or weigh anchor when the wind increases (OCIMF, 2008; Gard AS & DNV GL, 2016). (3) *Monitoring and coordination*: coordination among the crew and routine monitoring of the weather, the ship's position, and the anchor should be improved so that the crew can respond immediately to dangerous situations (IMO, 2011). This study is limited by the absence of recorded data on water depth, wind direction, and the actual distance dragged, which would allow a quantitative assessment of the holding force.

## 4. CONCLUSION

This study concludes that the anchor dragging of MV Aquagenie 1 at Yeosu Anchorage was caused by a combination of internal factors, namely a suboptimal choice of anchoring position, negligent anchor watchkeeping, and an insufficient length of chain, and external factors, namely bad weather with wind speeds of about 35 knots and a seabed that provided limited holding. Ships are advised to prepare more thoroughly before anchoring, to provide regular training for the crew, to adjust the length of chain to the depth and the weather forecast, and to improve anchoring and anchor watch procedures to avoid similar risks in the future.

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