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Analysis Of The Cause Of Pressure Drop In The Hydraulic Windlass Pump On MV.Talent Blu

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Abstract

The problem explored in this study is the decrease of the hydraulic pressure that occurred in the hydraulic windlass system, so that the operation of the anchor heave-up is not optimal. The windlass must have enough hydraulic pressure to properly hoist anchor chain and anchor. This study examined the reasons for the decrease in hydraulic windlass pump pressure and the corrective actions which were made by the crew to correct the issue. The approach taken in doing the research was descriptive qualitative. The author's sea-practice period was on board MV. Talent Blu was collected by direct observation, interviewing with one Chief Engineer (KKM), and Three Engineers/Masinists, and documentation. The results showed that both contamination and blockage of the hydraulic filter and leakage in the hydraulic hose pipe/piping system were to blame for the loss of hydraulic windlass pressure. The clogged filter reduced hydraulic oil flow and leakage in the oil led to oil loss and lowered hydraulic oil pressure and flow to the hydraulic motor. This caused the lifting speed to reduce and the windlass to give poor performance. The corrective actions were the following: stop operation, depressurize hydraulic system, inspect and clean/change filter, repair/replace leaky hose pipe/piping, check hydraulic oil level, add 25 liters of hydraulic oil, and run system test post repair. The results also provide guidance on enhancements to the Planned Maintenance System (PMS) namely regular checking on filter, hose pipes/piping, hydraulic pressure, hydraulic oil level and condition as well as availability of spare parts to speed up repair when failure occurs.

Keywords: Hydraulic Windlass, Hydraulic Pressure, Hydraulic Filter, Hose Pipe Leakage, Planned Maintenance System

1. INTRODUCTION

The anchor windlass is one of of the important auxiliary machines on board a ship that plays a significant role in supporting anchoring and anchor retrieval operations. In a hydraulic windlass system, the power required to operate the anchor handling mechanism is generated through hydraulic oil pressure and flow supplied by a hydraulic pum. Adequate hydraulic pressure is essential to ensure that the heave-up and lowering processes can operate properly. When the hydraulic pressure decreases, the ability of the windlass to lift the anchor and anchor chain may be reduced, potentially affecting the efficiency of ship operations. Therefore, maintaning the hydraulic pressure within the require operating range is an important aspect of ensuring the reliability of the anchor handling system [1].

The problem of decreased pressure in hydraulic windlass systems has been discussed in several previous studies [2], in a study conducted on MT. Transko Taurus, found the decrease in hydraulic windlass pressure was associated with damage the O-ring seal, insufficient tightening of the fitting valve, and improper functioning of the ball valve. The study used a fishbone approach to identify the factor contributing to the problem. Meanwihle, [3] in a study on MV. Permata, found tha decreased hydraulic windlass pump pressure was caused by inadequate hydraulic system maintenance, which subsequently resulted in leakage in the piping system. These finding indicate that the condition of hydraulic components and implementation of maintenance activities are important factors affecting the perfomance of the hydraulic windlass system.

An investigation into this problem is important because a contaminated and clogged hydraulic filter can slow the flow of hydraulic oil through the system and leakage in the hose pipe/piping can cause hydraulic oil loss and decrease the hydraulic oil pressure supplied to the hydraulic motor [12], [14], [15]. Under such

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conditions they can lead to poor anchor lifting rates, and have the potential of interfering with the heave-up operation. Thus, the only way to determine the actual cause of the pressure loss, as well as the measures taken by the crew to rectify the situation, is to actually investigate it. The results will also be used to assess the Planned Maintenance System (PMS) in terms of the inspection and maintenance of hydraulic windlass system components, such as filters, hydraulic piping, oil levels, etc [4].

In the context of these considerations, the aim of the present study is to analyze the reasons for the reduction of the pressure of the hydraulic windlass pump on board MV. Talent blu, conditions of the hydraulic filter and hose pipe/piping system leakage. In this study the effect of reduced pressure on the hydraulic windlass performance is also to be identified and the actions taken by the crew to rectify the problem. The following benefits are anticipated from this study: For ship crews, the study will provide practical information on how to identify and respond to pressure reduction in the hydraulic windlass system and as a reference for further development of the Planned Maintenance System to support reliable and optimal anchor-handling operations [5].

2. METHODS

The method used in this study is descriptive qualitative, This is a non-experimental method used in this study with the aim of analyzing the cause of the pressure drop of hydraulic windlass pump on MV. Talent Blu. Research objects studied were the hydraulic windlass system, hydraulic pump, hydraulic filter, hose pipe/piping system, hydraulic motor and hydraulic oil. This work was carried out while the author was at sea, during his sea experience on board MV. Talent Blu. Data collection for the sea-practice period was carried out for 12 months starting from 30th July 2024 to 31st July 2025. Primary data were gathered by direct observation of the operation of the hydraulic windlass and interviews with engine-room crew who operate and maintain the windlass. Two informants one Chief Engineer (KKM) and Three Engineers/Masinists directly involved in or knowledgeable of the operation, inspection and maintenance of the hydraulic windlass) were interviewed. Secondary data was taken from onboard documentation, maintenance records, hydraulic equipment manual and other documents related to the hydraulic system.

This study was carried out in normal operating mode and during operation under the condition of pressure drop of the hydraulic windlass. The variables remained constant were the hydraulic windlass, hydraulic pump, hydraulic motor, hydraulic filter, and hose pipe/piping system, and the variables which changed were the hydraulic pressure, hydraulic oil level and condition, filter condition, hose pipe/piping condition, and anchor lifting performance. The research process began with the process of observing the heave up process, in which a record was made of the operating condition and hydraulic pressure. When a pressure drop was observed, the hydraulic filter and hose pipe/piping system was tested to see if there was any contamination, blockage or leakage. The Two informants in the engine room were then interviewed using a semi-structured interview technique to gather information on accident causes of the pressure reduction, previous maintenance activities, and corrective actions. The data obtained were correlated with maintenance records and equipment manuals and then analyzed descriptively to determine the correlation between the condition of the hydraulic components and the pressure drop [4].

The hydraulic windlass, hydraulic pump, hydraulic motor, hydraulic pressure gauge, hydraulic filter, hose pipe/piping system, and hydraulic oil tank were the main equipment used in this study. The equipment that was used to aid in maintenance during the inspection was also counted as supporting equipment. Materials used were hydraulic oil, filter elements, hose pipe/piping elements and sealing parts. The descriptive qualitative method was selected as the method because it allows the study of technical problems in real situations without experimental manipulation, by observing, interviewing, and documenting. The benefit of this approach is that it gives detailed information of the actual condition of the hydraulic system, however the downside of this is that the outcomes are dependent on the conditions of MV. Talent Blu is not necessarily a representative of all hydraulic windlass systems.

3. RESULTS AND DISCUSSION

The results showed that the pressure drop in the hydraulic windlass system on MV. The performance of the anchor retrieval was impacted by Talent Blu. In the anchor heave-up operation at Sidor Port, Venezuela on 30 September 2024, the problem arose. The hydraulic windlass had a working pressure of 15.7 MPa, anchor lifting

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speed of 9 m/min, rated load of 181 kN and drum speed of 8.5 rpm under normal conditions. When the incident occurred, the anchor speed reduced to about 4-5 m/min and the drum speed could not be above 4 rpm even with the remote control set to the maximum. There were also abnormal noises and vibration observed around the windlass unit.

Tabel 1. Hydraulic Windlass and Hydraulic Pump Specification

Parameter	Specification
Windlass type	Mitsubishi
Working load	208 kN
Chain size	Ø70 G2 K shackle
Drum speed	0–8.5 rpm
Rated lifting speed	9 m/min
Maximum speed without load	23 m/min
Brake capacity	1161 kN
Rated working pressure	15.7 MPa
Hydraulic pump type	MKV-23H-RFA-C10-L-11
Maximum pump flow	390 L/min
Rated pump pressure	21.1 MPa
Maximum pump pressure	24.5 MPa

As seen in the specifications in Table 1 the hydraulic windlass must be maintained at a steady hydraulic pressure to get its rated performance. The working pressure of hydraulic motor is 15.7 MPa, and the hydraulic pump rated pressure is 21.1 MPa, maximum pressure is 24.5 MPa. So, when it was observed that the pressure was reduced during the incident means that the hydraulic power which was transferred into the motor was not enough to maintain the normal drum rotation speed and lifting speed. There is also a consistency of the relationship with the theoretical explanation in the thesis, which is based on hydraulic pressure and flow and could determine the power available for the hydraulic motor operation[6], [7].

Tabel 2. Hydraulic Windlass Condition During The Incident

Parameter	Normal Condition	Condition During Failure
Pressure at hydraulic motor	15.7 MPa	7.5–9.0 MPa
Anchor lifting speed	9 m/min	4–5 m/min
Drum rotation	8.5 rpm	< 4 rpm
Hydraulic oil volume	115 L	Decreased significantly
Hydraulic filter	Clean	Contaminated/clogged
Hose pipe/piping	No leakage	Leakage

It can be seen from Table 2 that the pressure at the hydraulic motor was reduced from 15.7 MPa to about 7.5–9.0 MPa. This is a significant drop from the rated working pressure. Meanwhile the lifting speed of the anchor was reduced from 9 m/min to 4-5 m/min and drum rotation from 8.5 rpm to less than 4 rpm. The decrease of these operating conditions indicates that the hydraulic pressure and hydraulic flow going to the hydraulic motor were not enough to provide normal mechanical output. The loss of oil volume (25 liters of hydraulic oil were added), also shows that there was a hydraulic oil loss during the failure.

One of the factors found to be associated with the pressure reduction was contamination and blockage in the hydraulic filter during the inspection. Dirt and contamination in the hydraulic oil was discovered in the filter, which is preventing the oil from flowing. This limitation curtailed the flow of hydraulic fluid to the hydraulic motor that was efficient. Based on the research data, the pressure reached at the motor under the condition of filter restriction is estimated to be 10.5–12.0 MPa, which is 23–33% lower than the rated pressure of 15.7 MPa. The limited flow also put more load on the pump, and was correlated with a rise in hydraulic oil temperature [14], [15].. The results reflect the theoretical discussion in the thesis, which states that dirty hydraulic oil can hinder flow and thus cause poor system performance.

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Figure 1. Contamined Hydraulic Filter

The second condition that was detected was leakage in the hose pipe/piping system from the pump to the hydraulic motor. The inspection identified that a fine crack in the outside rubber layer of the hose allowed hydraulic oil to leak through the system when it was under pressure. The leakage resulted in a loss of flow; some hydraulic oil provided by the pump was lost before it reached the hydraulic motor. The leakage, in addition to the pressure reduction that was brought about by the restricted flow through the contaminated filter, resulted in a further pressure reduction of around 7.5-9.0 MPa. The anchor, therefore, could not lift at the desired speed with the rated torque of the hydraulic motor[8].

The hydraulic mechanisms related to these conditions can be understood based on the relationship between hydraulic pressure, flow and flow resistance in the hydraulic system [11]. Hydraulic oil is pumped from the hydraulic pump to the hydraulic motor via the filter and hose pipe/piping system. Normally the hydraulic motor needs to have sufficient hydraulic flow and pressure to power the windlass. If the hydraulic filter gets contaminated or clogged with hydraulic oil, the flow of the hydraulic oil is limited. This resistance is referred to as back pressure and will proportionately decrease the hydraulic flow and pressure through the filter to the hydraulic motor. Under the condition of restricting the filter, the pressure of the hydraulic motor was estimated in this study as 10.5–12.0 MPa while the hydraulic motor's normal operating pressure is 15.7 MPa.

This is a reduction of about 23-33% from the normal working pressure. The limited flow rate also put more pressure on the hydraulic system and was found to be linked with the rise in hydraulic oil temperature [6], [7]. The other hydraulic loss was caused by the leakage in hose pipe/piping system. Hydraulic oil leaked out through the hose crack during pressurization indicating a loss of hydraulic oil before it entered the hydraulic motor from the pump. As a result, useful hydraulic oil flow was therefore reduced to the motor. The hydraulic oil volume decrease during the incident and the hydraulic oil replenishment performed after the incident with 25 liters of hydraulic oil further confirms the occurrence of hydraulic oil loss. So the contaminated filter mainly impeded the flow path and the leaking hose pipe/piping resulted in a loss of hydraulic oil from the pressurized system.

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Figure 2. Hydraulic Oil Leakage from the Hose/Piping System During Operation

This is due to the synergic effect between the two conditions. Hydraulic oil was lost due to a leaky hose pipe/piping system and a contaminated filter was restricting hydraulic oil flow. This led to a reduction in the hydraulic motor's pressure and flow. This is the reason for the decrease in the lifting speed from 9 m/min to 4-5 m/min and drum rotation from 8.5 rpm to less than 4 rpm. The finding is in line with the previous studies discussed in the thesis [4] found that the hydraulic pressure could decrease and hydraulic temperature may increase due to insufficient maintenance of a hydraulic windlass system, while [5] found that the condition of components, quality of hydraulic oil and the discipline of maintenance of the hydraulic system affect the reliability of an anchor system. The present finding is one in which filter contamination and hose leaks were found simultaneously in the same hydraulic windlass system.

Engine-room men systematically implemented the corrective actions. The windlass operation was first stopped and the hydraulic system depressurised. An inspection and cleaning of the hydraulic filter was then conducted or replaced if it could no longer be used. The hose pipe was replaced with another hose pipe with a working pressure of 21.1 MPa and a maximum pressure of 24.5 MPa. The hydraulic oil level was also checked and 25 litres of hydraulic oil was added and the level was brought up to the high mark on the hydraulic oil sight glass. Once the repair was completed, the system was tested gradually, starting at low pressure, and working up to a pressure of 15.7 MPa, which is the rated working pressure. The pump was also tested at its rated pressure of 21.1 MPa and its maximum pressure of 24.5 MPa.

Tabel 3. Comparison Before And After Repair

Parameter	Normal Condition	During Failure	After Repair
Pressure at *hydraulic motor*	15.7 MPa	7.5–9.0 MPa	15.2–15.9 MPa
Anchor lifting speed	9 m/min	4–5 m/min	9 m/min
Maximum speed without load	23 m/min	Not measured	23 m/min
Drum rotation	8.5 rpm	< 4 rpm	8.5 rpm
Hydraulic oil volume	115 L	Decreased	Normal, *high mark*
Hydraulic filter	Clean	Contaminated	Clean
Hose pipe/piping	No leakage	Leakage	No leakage
Hydraulic oil temperature	Normal	High	Normal
Hydraulic oil level	Normal	Low	Normal

The table 3 shows improvement in the operating condition due to the corrective actions. The hydraulic pressure rose from 7.5-9.0 MPa at the failure to 15.2-15.9 MPa after repair, a value near to the normal value of 15.7 MPa. The anchor lift speed was brought back to 9 m/min and the drum rotation back to 8.5 rpm. The hydraulic filter was cleaned, the leakage was fixed and the hydraulic oil level and temperature were re-set to normal. These changes suggest that there was a direct relationship between restoring hydraulic oil flow and preventing loss of fluids and windlass performance[9].

The contribution of this case study to science is in the identification of the relationship between the condition of hydraulic system components and hydraulic windlass performance degradation on board MV. Talent Blu. This study contrasts with previous studies that primarily reported hydraulic windlass failures due

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to issues with individual windlass components, such as damaged O ring seals, fitting valves, ball valves, hydraulic pump damage, or leaky pipe/hose connections and focuses on the impact of a contaminated hydraulic filter and leakage in the hose pipe/piping system on hydraulic pressure reduction. The extra technical contribution is shown by a quantitative comparison of the operating conditions before, during and after failure.

The hydraulic motor pressure reduced from 15.7 MPa to 7.5–9.0 MPa, the lifting speed of the anchor reduced from 9m/min to 4–5 m/min and the rotation speed of the drum reduced to less than 4 rps. Finally, the pressure of the hydraulic motor reached 15.2-15.9 MPa after the corrective action, and the speed of the anchor was restored to 9 m/min, and the drum rotation was restored to 8.5 rpm. This study gives quantitative information about the relation between hydraulic pressure reduction and anchor heave-up degradation. In addition, the study offers further technical information by showing a combined restriction of flow due to filter contamination with loss of hydraulic oil due to hose pipe/piping leakage can lead to a larger loss of hydraulic motor pressure and windlass performance. This discovery also offers a practical approach to enhance the effectiveness of the Planned Maintenance System (PMS) by routinely checking hydraulic filters, hoses, piping, hydraulic oil level, oil temperature, pump pressure and the performance of hydraulic motors [4],[5].

The results indicate the need for a consistent application of the Planned Maintenance System (PMS). The maintenance recommendations from the research are to check hydraulic hoses, piping, fittings, oil filters, oil level, oil temperature, pump pressure and hydraulic motor frequently. The research also calls for periodic oil and filter change every eight months, every three months check of the band brake, every six months check of anchor chain, check the clutch lubrication every month, and minor overhaul of pump and hydraulic motor every year. These activities of maintenance are done to identify leakage, contamination and component deterioration before the operating pressure of the windlass is compromised[10].

The proposed periodic maintenance (PMS) intervals should be determined from the manufacturers maintenance recommendations, equipment operating hours, equipment condition, hydraulic oil condition and company PMS needs. This is to enable the frequency of inspection and maintenance to be modified as per the manufacturer's specification and as per the actual operating condition of the hydraulic windlass. In addition, it is in line with the International Safety Management (ISM) Code which focuses on the systematic procedures to ensure maintenance of ship machinery and equipment. The recommended maintenance timetables are thus recommended for MV. Talent Blu is not to be used as standard intervals for all hydraulic windlass systems.

Special emphasis on cleanliness of the hydraulic filter, hoses and pipes integrity, leakage, hydraulic pressure, oil level and temperature, and performance of hydraulic motors. Any unusual condition is to be recorded in the PMS and corrective maintenance should be carried out. All critical spare parts (such as filter elements, hoses, sealing components, fittings and hydraulic oil) should be changed according to manufacturer specification or vessel requirements. The effectiveness of the PMS can be enhanced and the risk of recurring hydraulic windlass pressure failures reduced by incorporating the manufacturer's recommendations, the ISM requirements, the company PMS procedures and the actual condition of equipment [4], [11], [13].

4. CONCLUSION

The hydraulic windlass pump pressure loss on MV. Talent Blu was determined from observations, technical inspections, interviews and documentation. MV. Talent Blu was caused by contamination and clogging of the hydraulic filter, and leakage in the hydraulic hose pipe/piping system. Hydraulic oil loss in the hydraulic motor caused by leakage in the hydraulic system, and the contaminated filter caused a decrease in the flow and pressure of hydraulic oil to the motor. As a result, the hydraulic motor pressure dropped from 15.7 MPa to 7.5-9.0 MPa, the speed of anchor lifting was reduced from 9 m/min to 4-5 m/min, and the drum rotation was reduced below 4 rpm. Corrective actions taken were: System was stopped, system was depressurized, check and clean/replace filter, Repair/Replace Leaking hose pipe/piping, Check Oil Level, add 25 liters of hydraulic oil and then test system gradually. Following repairs, the pressure was raised to 15.2-15.9 MPa and the lifting speed and drum rotation were restored to 9 m/min and 8.5 rpm, respectively. In the practical sense, these results stress the need for preventive maintenance by periodic maintenance of the filters, hoses, piping, hydraulic oil, pressure and motor performance. The following are suggested as future lines of research: quantitative hydraulic performance analyses for evaluating pressure, flow rate, temperature and motor performance; condition-based maintenance techniques, including monitoring and trend analysis to identify and indicate early system degradation.

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