

Tug Boat Monitoring Fuel Oil Consumption by Using Flow Meter

DANNY FATURACHMAN, SHAHRIN FEBRIAN, T.D. NOVITA, ACHMAD DJAENI

Marine Engineering Department

Darma Persada University

Jl Radin Inten II, Pondok Kelapa Jakarta 13450

INDONESIA

fdanny30@yahoo.com<http://www.unsada.co.id>

Abstract: - A system in a ship must include the ability to monitoring the fuel use rates are burned from the bridge of a ship. Including speed (the use of) fuel that is burned on each main engine help, or machines as well as high in the surface of fuel tanks. An instrument for measuring of the flow called flow meter. On a large ship, usually flow meter has been already installed since built to monitor the use of fuels. On a small ship, usually did not / not fitted flow meter because too expensive, and the measurement of using fuel only devised by a system of package. PT Nusantara Terminal Terpadu (NTT) is company services provided sea transportation that focuses on sea transportation which includes a barge intensity and ship for transporting coal, ranging from dredging, loading-unloading until transporting. In this research, PT. NTT have some of tug boat, a small vessel assigned to pull or push larger vessels in port. Besides the tug is also serves to draw barges contains coal which comes from treatment coal plant to be brought to the port place and after that carried out to the trucks. PT. NTT devise a system design installation itself and cheap, and also can contribute to discharging fuel on ships efficiently.

Key-Words: -consumption, flow meter, fuel oil, monitoring, PT. NTT, tug boat

1 Introduction

Fuel or commonly called fuel oil is one goods important need for residents and holding, also have a very vital role in all our activities economy. There are three main users of fuel oil: for household, industrial and transportation. Fuel used humans for the process of combustion where fuel will release heat after being reacted with oxygen in the air. Process another to release energy from fuel is through isothermal reaction and nuclear reaction (as nuclear fission or nuclear fusion). Hydrocarbons (including those gasoline and solar) is the fuel type which often used by human being. Other fuel which can also worn is radioactive metallic.

Flow meter is an instrument for measuring the quantity or rate of fluid flow that flows in a pipe or connection open. This device consisting of primary device, called as a measuring instrument primary and secondary device. Flow meter commonly consists of two parts, instrumental and secondary aids. Instrumental produce a signal that respond to the flow because the rate of flow has been interrupted. The main instrument is an annoying flow, orifice rate which is causing the occurrence of decrease the pressure. Secondary aids receives signals and displays, of instrumental record and / or transmitted as measurement result of the flow.

2 Problem Formulation

PT. Titan group is a company that moves in information technology, resources, energy, mining logistic & services. PT. Titan group owned company shareholder in systems integration, ranging from Information Technology business process outsourcing / employment, services logistician / carting, business oil and coal mining. One of subsidiary of PT Titan is PT Nusantara Terminal Terpadu (NTT). One large project of NTT have established cooperation with the government for transporting coal to nuclear power plant (PLN) in Pelabuhan Ratu, West Java.

A fleet of ships owned: MV. Titan 70, MV. Titan 42, TB. Titan 01, TB. Titan 03, TB. Titan 05, TB. Titan 07, TB. Titan 09, TB. Titan 11, TB. Titan 13.

PT. NTT had asked the offer price to some contractors censorship flow meter on the market, but the price is very expensive (already includes a tool and installation flow meter system). For the flow meter it is not too expensive, but the installation system is very expensive. Therefore PT. NTT devise a system design installation itself and cheap, and also can contribute to discharging fuel on ships efficiently.

3 Problem Solution

The beginning of the ship operation in March 2011 even had several months to applied discharging fuel per package and had very high reaching 200 litres per hour. It is expected to allow the speed of ships can be

based on target, but in December 2011 they made changes to decline the discharging fuel to become 150 litres per hour. After 4 months running, it occurs the protest by ship crew due to the absence of reference rules by using of fuel discharging size. In April 2012, they made the second change by raising a little discharging fuel to be 160 litres per hour and walked till May 2014. From June 2014, the flow meter already existing in most of the PT. NTT's ship and the data collection was recorded from July until November 2014.

Table 1. Ship Main Engine Fuel Oil Consumption per-hour History

History of ME FO Consumption Per-Hour			
2011	3	Mar	200
	4	Apr	200
	5	May	200
	7	Jun	200
	7	Jul	200
	8	Aug	200
	9	Sep	200
	10	Oct	200
	11	Nov	200
	12	Dec	150
	1	Jan	150
	2	Feb	150
2012	3	Mar	150
	4	Apr	150
	5	May	160
	7	Jun	160
	7	Jul	160
	8	Aug	160
	9	Sep	160
	10	Oct	160
	11	Nov	160
	12	Dec	160
	1	Jan	160
	2	Feb	160
2013	3	Mar	160
	4	Apr	160
	5	May	160
	7	Jun	160
	7	Jul	160
	8	Aug	160
	9	Sep	160
	10	Oct	160
	11	Nov	160
	12	Dec	160
	1	Jan	160
	2	Feb	160
2014	3	Mar	160
	4	Apr	160
	5	May	160
	6	Jun	140
	7	Jul	140

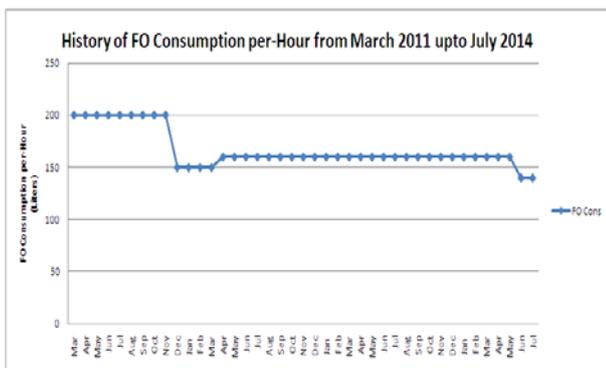


Figure 1. History of FO Consumption per hour from March 2011 till July 2014

Methods used in this research was descriptive methods described a phenomenon, events, incidents happened and focus on actual problem. The analysis was quantitative analysis with doing a calculation use of fuel before and after using flow meter on tugboat. Because almost the tugboat have the same main engine, in this research only 2 tugboat which done for the calculation.

DATA OF THE SHIP:

Ship Name no. 1: TITAN 03

Ship type : Steel Tug Boat
 Owner : PT. NTT
 Flag : Indonesia
 Ship Class : BKI
 GRT / NRT : 255 GT / 77 GT
 Length (LBP): 26,04 m
 Length (LOA): 28,05 m
 Breadth : 8,60 m
 Depth : 4,30 m
 Total Crew : 11 crews
 Shipyard : PT. Bandar Abadi, Tanjung - Uncang, Batam
 Main Engine : Mitsubishi S6R2-MPTK, 1030HP/1450rpm x 2units
 Effective H.P: 2 x 759 KW
 Auxiliary Engine: Marine gen setHUANG FENG 50 KW x 2units
 Fresh Water Tank: capacity59 Ton
 Fuel Oil Tank :capacity 185 Ton
 Ballast Water Tank: capacity93 Ton
 Daly Tank : capacity 5000 liters
 Fuel oil type : High Speed Diesel

Ship name no. 2:TITAN 05
 Ship type : Steel Tug Boat
 Owner : PT. NTT
 Ship Class : BKI
 GRT / NRT : 255 GT / 77 GT
 Length (LBP) : 25,12 m
 Length (LOA) : 28,00 m
 Breadth: 8,60 m
 Depth: 4,30 m
 Total Crew : 11 crews
 Shipyard : PT. Bandar Abadi, Tanjung- Uncang, Batam
 Main Engine : Mitsubishi S6R2-MTK3L, 1030 HP/1450RPM x 2
 Effective H.P: 2 x 759 KW
 Auxiliary Engine: Marine genset HUANG FENG 50 KW x 2units
 Fresh Water Tank: capacity 59 Ton
 Fuel Oil Tank : capacity 185 Ton
 Ballast Water Tank: capacity 93 Ton
 Daily Tank : capacity 5000 liters
 Fuel oil type : High Speed Diesel

For measuring the efficiency, shipping route is one of the important thing where fuel consumption could be set with the length of time of sailing vessel. The route is from Bengkulu (Sumatera) to Pelabuhan Ratu (West Java).

SCHEME FOR FLOW METER ON BOARD:

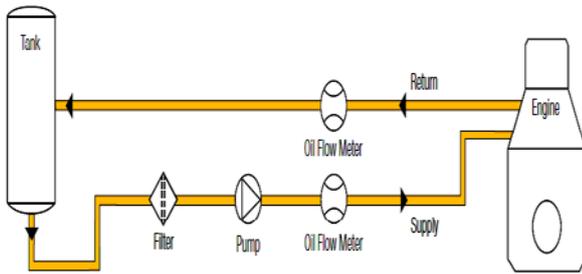


Figure 2. Scheme of flow meter on board

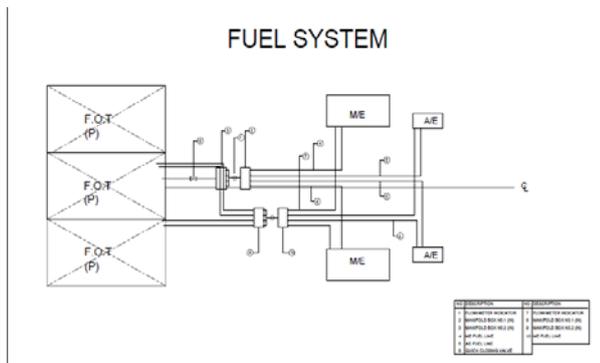


Figure 3. Fuel system that already installed flow meter on Titan 03 & Titan 05

On Figure 3, at this stage, the main engine check on manually using daily tank that has been designed to know the capacity of the average rate of the flow (flow rate). Flow rate measured for rotation per minute (rpm) on maximum and minimum machine condition. A tank artificial has installed for measuring instrument to know how much fuel capacity which already exist at the daily tank. Fuel from the tank artificial enter to play the engine then the fuel that were not burned enter into overflow shelter.



Figure 4. Daily tank



Figure 5. Daily tank pipe to Main Engine (M/E)



Figure 6. Overflow from M/E to daily tank

Table 2. Flow rate on Titan 05

Start Hour	Finish Hour	Rpm	Speed	Inlet (liters)	Overflow (liters)	Consumption (liters)
11.48 am	12.48 am	700	2,5	48 liters	42	6
13.04 am	14.04 am	900	3,90	53 liters	31	22
14.49 am	15.59 am	1200	5,30	82 liters	48	34

From above table, an inlet minimum on 700 rpm with an overflow as many as 42 liters /hour. While overflow maximum happened on the 1200 rpm as many as 82 liters/hour so specification for flow meter needed a minimum flow rate under 42 liters/hour and maximum flow rate above 82 liters/hour. Temperature at the outlet when rpm maximum is 43°C. Specification of flow meter that used for:

- Name : Contoil vzo 8
- Brand : Aqua Metro
- Maxflow&Min flow : 200 l/h & 4 l/h
- Temperature : 60°C



Figure 7. Erection of flow meter (before)



Figure 8. Erection of flow meter (after)

To know the movement and fuel consumption on Titan 03 and 05 everyday crew sent the data to a company. For the data prior before using the flow meter recorded from March till May 2014, and for the data after using flow meter taken from period of August till November 2014.

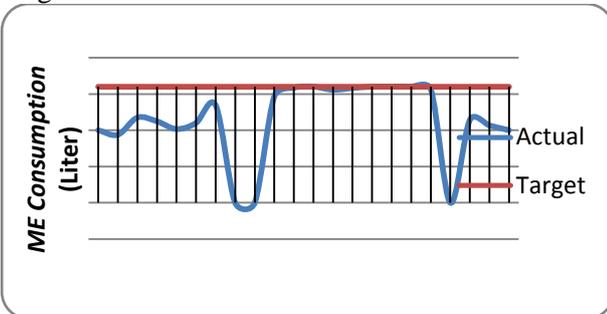


Figure 9. Graph of Titan 03 Fuel Oil M/E Consumption on March 2014

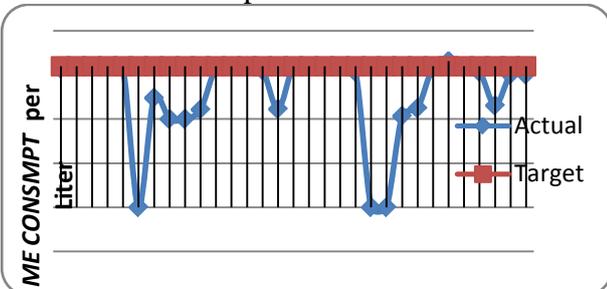


Figure 10. Graph of Titan 05 Fuel Oil M/E Consumption on March 2014

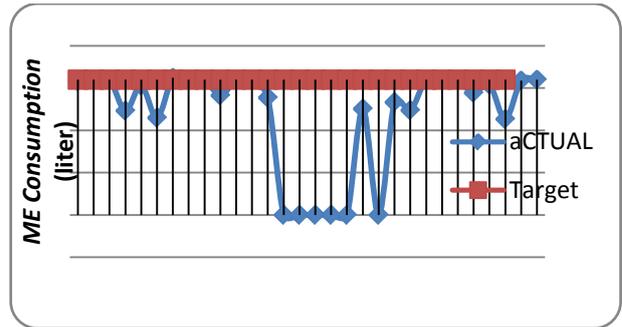


Figure 11. Graph of Titan 03 Fuel Oil M/E Consumption on April 2014

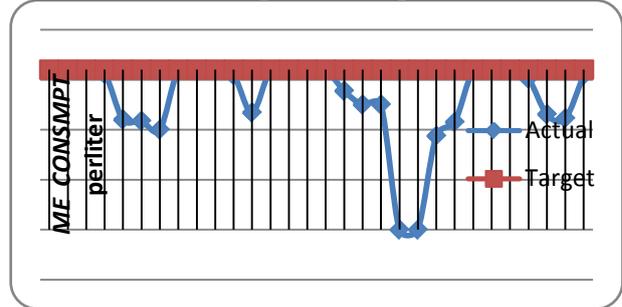


Figure 12. Graph of Titan 05 Fuel Oil M/E Consumption on April 2014

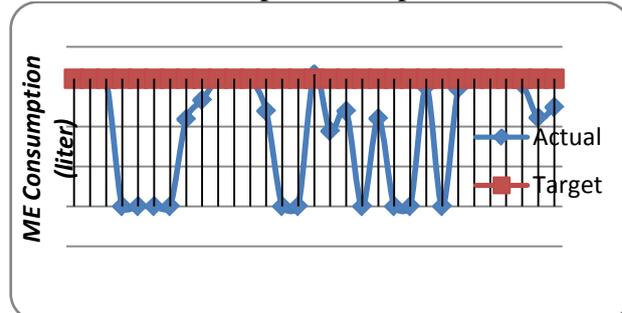


Figure 13. Graph of Titan 03 Fuel Oil M/E Consumption on May 2014

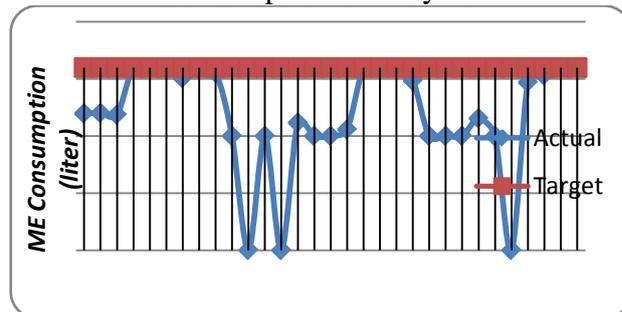


Figure 14. Graph of Titan 05 Fuel Oil M/E Consumption on May 2014

PT. NTT in July started using flow meter to know the consumption of fuel used in. Based on result of the survey observed of the company, they determined discharging fuel consumption 140 liters/hour on sail condition and 60 liters/hour on condition of the ship in the harbor by setting max rpm on ships worth 950 rpm.

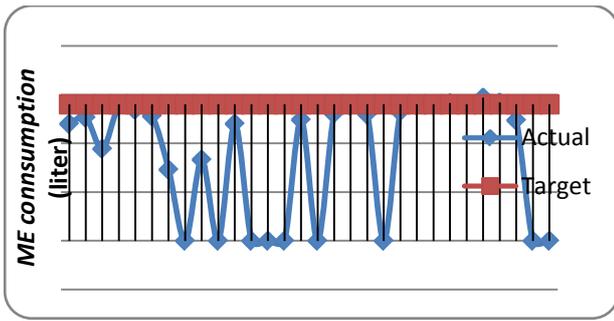


Figure 15. Graph of Titan 03Fuel Oil M/E Consumption on Sept 2014

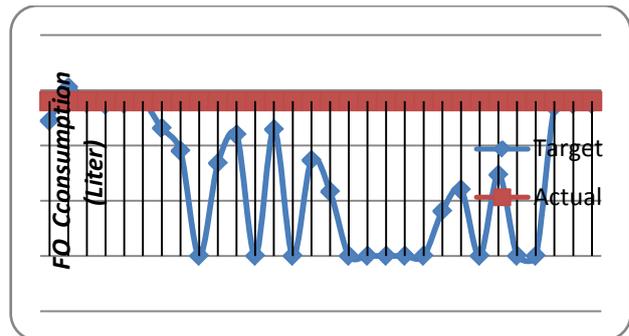


Figure 19. Graph of Titan 03Fuel Oil M/E Consumption on Nov 2014

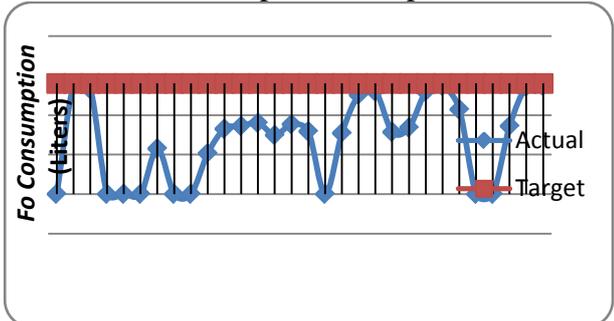


Figure 16. Graph of Titan 05Fuel Oil M/E Consumption on Sept 2014

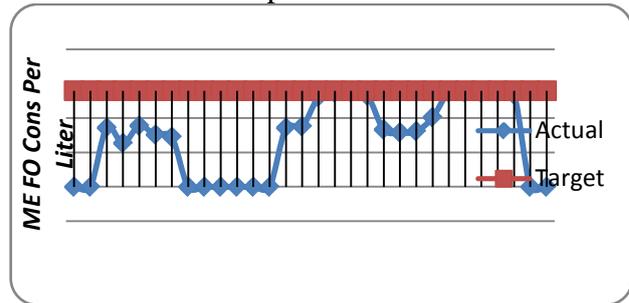


Figure 20. Graph of Titan 05Fuel Oil M/E Consumption on Nov 2014

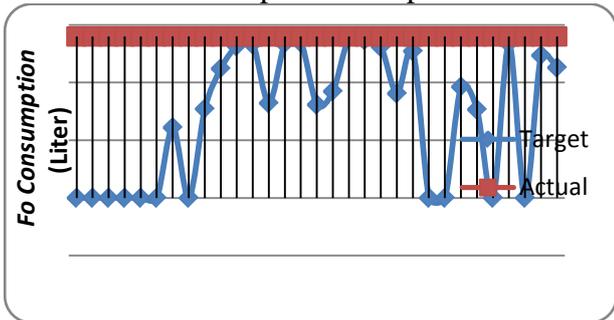


Figure 17. Graph of Titan 03Fuel Oil M/E Consumption on Oct 2014

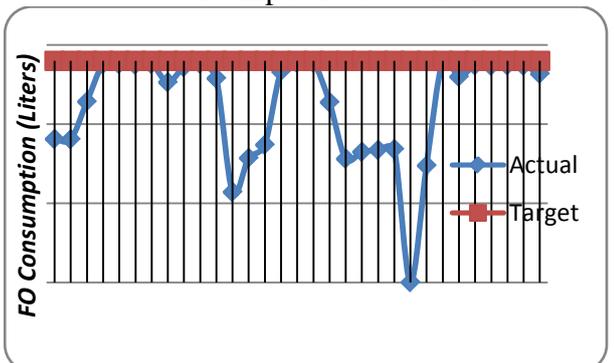


Figure 18. Graph of Titan 05Fuel Oil M/E Consumption on Oct 2014

Table 3. Fuel Oil Consumption before flow meter erection

Ship Name	Shipping Trip	Start	Finish	Actual			
				Shipping Length		FO Cons	
Titan 03	Bengkulu-Pel.Ratu-Bengkulu	28-Apr	23-May	26.00	Days	38.285	Liters
Titan 05	Bengkulu-Pel.Ratu-Bengkulu	3-May	28-May	25.00	Days	41.327	Liters

flow meter erection

Table 4. Fuel Consumption after flow meter erection

Ship Name	Shipping Trip	Start	Finis h	Actual			
				Shipping Length		FO Cons	
Titan 03	Bengkulu - Pel.Ratu-Bengkulu	1-Nov	30-Nov	29.00	Days	34.501	Liters
Titan 05	Bengkulu - Pel.Ratu-Bengkulu	26-Oct	20-Nov	26.00	Days	32.557	Liters

Total efficiency discharging fuel after using the flow meter:

$$\text{Titan 03: } \frac{38.285 - 34.501}{38.285} \times 100\% = 9,883\%$$

$$\text{Titan 05: } \frac{41.327 - 32.557}{41.327} \times 100 \% = 21,220 \%$$

4 Conclusion

1. Fuel consumption before using flow meter for Titan 03 shipping trip Bengkulu-Pelabuhan Ratu-Bengkulu from April to May worth 38,285 liters and Titan 05 shipping trip the same worth 41,327 liters.
Fuel consumption after using flow meter for Titan 03 shipping trip Bengkulu-Pelabuhan Ratu-Bengkulu from April to May worth 34,501 liters and Titan 05 shipping trip the same worth 32,557 liters.
2. For controlling the fuel consumption before using the flow meter with sounding test on the tank, after using the flow meter we can use the authorized picture of oil consumption which list on the flow meter.
3. The efficiency of fuel oil consumption after using the flow meter:
Titan 03 is 9.833 %
Titan 05 is 21.220%

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