

# Simplifying Hydrocarbon Removal Activity by using SMART Skimmer

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**P**etroleum Nasional Berhad, widely known as PETRONAS is Malaysia's National Petroleum Corporation which was established in 1974 and is wholly-owned by Malaysian Government. PETRONAS evolved from being a National Oil Company (NOC) and regulator into being a fully integrated multi-national oil and gas company in more than 60 countries. PETRONAS stands as the sole custodian for Malaysia's national oil and gas resources in which PETRONAS explores, produces and delivers to meet the society's needs. Its operation covers upstream, downstream, product manufacturing and marketing. Some of the end products for PETRONAS are Liquefied Natural Gas (LNG), gasoline, diesel and jet fuel. On the other hand, some of their petrochemical products are ethylene/polyethylene, MTBE, fertilizers, LPG and etc.

**PETRONAS Penapisan (Terengganu) Sdn Bhd (PP(T)SB) which is located in Kerteh, Terengganu is one of the subsidiary companies of PETRONAS. It is known as Malaysia's first oil refinery company with three main processing units namely refinery, aromatics and oil movement & shipping. There are six gas processing plants and the refinery processes 49,000 barrels of crude oil per day. PP(T)SB aims to be a Pacesetting Hydro skimming Refinery and Distinctive Aromatics Managing Operator.**

In addition to this, the organisation has also received the Chemical Industries Council of Malaysia (CICM) Responsible Care Awards 2013/2014 and was re-certified for ISO14001:2004 (EMS) and ISO9001:2008 (QMS). All these achievements prove that PETRONAS believes in continuous improvement.



## Standing together to be better

It is extremely essential that all personnel participate in ensuring Quality Management System in improving efficiency and reducing operational costs. It is also vital that they stand together in facing challenges from international market and deal well with market globalisation. Not only that, it is also crucial that every member of the organisation is able to adapt the right tools, methods and concepts that would enhance performance growth and minimise errors.

In addition to that, it is also important for them to utilise resources effectively in making the organisation a world-class manufacturer. The objectives set by PP(T) SB in relations to Health, Safety and Environment (HSE), operations, saving and strategic initiatives serve as a guide in making improvements. At the same time, the employees are encouraged to embrace PETRONAS's Shared Values through global championship mindset and behavior.

## Identifying barrier: The difficulty of removing Hydrocarbon (HC)

Having an objective of being the best in the industry, a team of five people from a diversified background was established in 2013 to identify the inefficiency in manufacturing. This team was called The Protégé and comprised of personnel from Production Engineer (Operation), Optimisation Engineers, Process Technologists and Advance Process Control (APC) Engineer. The Protégé aimed to eliminate the difficulties in removing hydrocarbon at First Flush Pit as this issue has become problem in the daily operations. This issue came to an attention during a brainstorming session among the members. Along that, 14 other issues were also identified and shortlisted for consideration. The issues were then validated using data gathering and analysis using Maintenance Management Software (MMS). Following that, the issues were grouped into four parts using Affinity Diagram. Then, Force Ranking Method and Prioritising Matrix were used to identify issues with high impact to the organisation.

Subsequently, the difficulties in removing hydrocarbon at First Flush Pit were defined using 5W 1H method. They discovered that the problem arose in early January 2012 where there were traces of Oil & Greases (O&G) with an average of 163 ppm which actually exceeded its intended limit of 100 ppm. The removal is usually done by pumping the oil layer at the top of the tank into a drum using flexible hose. This process of removal is tedious and not all hydrocarbons are removed from the substance. Usually this process involves two people. Furthermore, the removal seemed to be a difficult process as not all areas could be covered. Upon getting a clear picture of the whole idea, The Protégé set a target to reduce O&G to 100 ppm based on overall design.

It was understood that a lower concentration of O&G would be able to increase the treatment reduce

chemical cost and ensure compliance of Standard B effluent discharge according to Environmental Quality (Industrial Effluent) Regulations 2009, Third Schedule. The second target is to achieve a cost reduction in time and manpower during the O&G removal from RM1,800 per month to RM300 per month.

This project is expected to impact the customers and stakeholders by ensuring a discharge of environmental friendly wastewater to the open sea as well as increasing productivity and improving work processes. In addition to this, the project will meet the regulations by Department of Environment (DOE) for Standard B effluent discharge, adherence to PP(T)SB Safety Policy, improvement in operational cost via reduction of manpower, sludge disposal and treatment cost.

**With all these betterment, this project and its outcome will reflect the company's reputation. The key stakeholders involved are HSE, Oil Movement & Shipping (OMS) and BT1 personnel), Client (Department of Environment) and PETRONAS as whole. The team decided to use PDCA approach throughout the completion of the project. The project was expected to be completed in 8 months, starting from November 2012 until July 2013.**



Oil layer appeared at the first flush pit.



The conventional removal activity is usually took 30 minutes/session that involved three operators.

## Simplifying Hydrocarbon removal using SMART Skimmer

The First Flush pit from the Process Unit consist water and hydrocarbon. The Protégé understood that a high hydrocarbon volume requires high frequency in removal/ skimming activity. This is to avoid from hydrocarbon flowing to the downstream system. In addition to this, the activity requires thirty minutes per session, with three personnel to complete the process. Moreover, it was difficult to remove the hydrocarbon. Therefore, The Protégé decided to use The Ishikawa and Relation analysis in which three root causes were identified namely, the submerge of hose during removal activities, unavailability of proper tools and procedure in hydrocarbon removal.

Following that, the team conducted a brainstorming session to address the root causes. Four suggestions were selected for further analysis using Plus-Minus-Interesting (PMI) methods. Based on the assessment, the design of the portable floating skimmer scored the highest. The skimmer will be redesigned for optimum operating cost, low complexity and safe operation and also to meet HSE requirement.

Not only that, the skimmer should be able to recover oil in varies level of thickness, irregular operations and with a minimal material construction. The table shows the root causes, proposed solution and actions taken.

Root Cause	Proposed Solution	Action Taken
The submerge of hose during removal activities	Design a new skimmer.  (Three designs were evaluated: <ul style="list-style-type: none"> <li>• Fixed weir floating skimmer with roller pulley</li> <li>• Adjustable weir floating skimmer with roller pulley</li> <li>• Rope type floating skimmer)</li> </ul>	The decision matrix analysis was used to determine the designs based on six criteria, namely, safety, minimal capital cost, minimum operating cost, effectiveness, operation ability and constructability. <ul style="list-style-type: none"> <li>• The adjustable weir floating skimmer with roller pulley was chosen for implementation.</li> <li>• The design included the following features:               <ul style="list-style-type: none"> <li>• Cage filter - to ensure only oil pass through the skimmer</li> <li>• Floater - for the skimmer to float</li> <li>• Adjustable weir-adjust based on layer thickness</li> <li>• Hole - oil pass through</li> </ul> </li> </ul> The new design skimmer is called SMART Skimmer.
Unavailability of proper tools to remove hydrocarbon		
Unavailability of procedure in hydrocarbon removal	To develop operating procedure.	Feedbacks were gathered from the Field Operators. The operating procedures were reviewed by the Subject Matter Expert (SME) and discussion with the stakeholders was held. Test run was conducted on the approved Operating Procedure. Job Safety Analysis (JSA) was also developed to ensure safety aspect. Shift briefing and risk assessment sharing was also conducted with all stakeholders in ensuring the message is cascaded down to all level.



The SMART skimmer intervention has eliminated the source of pollutant and reduced the cost of dewatering.



The first test run was conducted for 10 days using the Smart Skimmer. The results showed that only one objective was achieved namely the reduction of O&G from 192 ppm to 98 ppm. However, the test run failed to show an improvement in the reduction of man power and time. Therefore, the team used Fault Tree Analysis to identify the root cause in not achieving the second target. The table below shows the issues and proposed solutions for not meeting the target.

Issue	Proposed Action
The instability of the operator when moving the skimmer manually	Provide barrier during operation
More personnel required to hold the skimmer and flexible hose	Provide roller pulley
Moving the skimmer was time consuming	Use roller to ensure easy movement

The SOP and JSA were reviewed after the installation of additional items such as roller pulley to suit the new skimmer. It was indeed a contentment to discover both target, lower concentration of O&G and cost reduction were achieved.

### Analysis of ICC project in PP(T)SB

The Innovative and Creative Circle (ICC) activities that were carried out by The Protégé have successfully reduced the O&G in Industrial Effluent Treatment System (IETS) from 182 ppm to 98 ppm. Consequently, there was also a reduction in the cost of

manpower and time; RM600 to RM 300 and 30 minutes to 15 minutes respectively.

The SMART Skimmer brought positive impact towards the improvement of Quality, Safety (Environment Legal Compliance), Image/Reputation and the stakeholders. With this skimmer, the downstream process of Industrial Effluent Treatment System (IETS) is improved by eliminating the source of pollutant as well as reducing the cost of dewatering. This is also parallel with the organisation’s goals of creating a hazard free environment and hence, complying to Standard B effluent discharge. Not only that, it is a joy to know that the marine life are also not affected by the hazard free disposal. In terms of health and safety issues, these steps have reduced ergonomic issues associated with the equipment handling with lesser manual intervention. On the other hand, this achievement indeed reflects a good image of the organisation.

### Matrix before and after ICC project:

Description	Before	After
Oil & Gases Reduction (ppm)	182	98
Manpower Cost (RM/month)	1,800	300
Time Taken to Complete (minutes/per session)	30	15
Number of staff	3	1
Value Creation and Cost Saving (RM/year)	0	1,534,200