TABLE OF CONTENT

STUDY OF OIL AND GREASE AND TOTAL PETROLEUM HYDROCARBONS IN BRUNEI BAY, BORNEO ISLAND, MALAYSIA

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INTRODUCTION

Oil and grease (O&G) and total petroleum hydrocarbons (TPH) have been recognized as two major pollutants that could degrade the marine water quality. The term O&G is used to describe solvent extractable organic matter from a sample matrix such as water and sediment (APHA, 1995). Composition of O&G varies with the solvent used in the extraction procedure. O&G extracted using polar solvents such as dichloromethane is primarily composed of biological lipids and mineral oil hydrocarbons. Mineral oil hydrocarbons are made up of diverse group of mixtures of hydrocarbons derived mainly from crude oil and its distillation products (UNEP, 1992).

Rapid development in industrialization has increased the demand for the petroleum related products. Transport of crude oil and its industrial derivatives by sea, use of fuel and lubricants in maritime activities and land based oily discharges have been known to cause oil pollution in the marine environment, where tanker oil spills and illegal discharges have caught worldwide public attention. Oil pollution may directly or indirectly cause impacts on the marine ecosystem such as coastal wetland, mangroves and also human health, as the pollutant enters the food chain of the ecosystems. In Malaysia, O&G is being monitored by the Department of Environment (DOE) in their marine water quality monitoring program since 1976 (Mohd Tahir *et al.*, 1999). This parameter is now listed as one of the seven parameters embedded in the Malaysian marine water quality index (DOE, 2013).

Brunei Bay is located to the north of the Malaysian Federal Territory of Labuan, to the northeast, east and south of the East Malaysia of Sabah and Sarawak, and the southwest by Brunei Darussalam, at coordinate of 4°45′-5°02′N, 114°58′-115°10′E. Brunei bay is an area covering many ecosystem such as estuaries, mangrove swamps, wetlands, and mudflats, which offer a vast array of biological diversity and productive ecosystems. Brunei Bay forms part of regional hydrological systems

and water resources, a natural barrier against strong tides, provides carbon storage and land erosion protection, and is also a breeding ground and habitat for wildlife. Considering the ecological importance of Brunei Bay, surprisingly little research has been conducted in this area. Mohamed *et al.* (1990) have conducted a water quality monitoring study to determine the impact of pulp and paper mill operation to Brunei Bay. These researchers used conventional water quality parameters such as dissolved oxygen, suspended solids, and biochemical oxygen demand as indicators to compare the water quality of the Bay before and after the mill operation. Their results showed that the mill operation appeared not to cause marked changes in the bay water quality during the first 16 months of operation. Waheed *et al.* (2007) conducted a study to determine the abundance and species composition of various marine flora and fauna in the Brunei Bay. In their study, several physico-chemical parameters such as salinity, dissolved oxygen, nitrate, phosphate and O&G were also monitored.

The present study was initiated to assess the O&G and TPH in the coastal and open seawater of the Brunei Bay. The data generated would serves as baseline information on the extent of contamination for management purpose to mitigate the detrimental inputs of O&G and TPH to the study area.

MATERIALS AND METHODS

The sampling areas were divided into two major segments. The first segment of the sampling area lies alongside of the Brunei Bay coastline between 0-5 km from the coast and was conducted at approximately 4 time intervals during May 2013, July 2013, October 2013, and January 2014 (station B1- B13 in Figure 1). The second segment of the study was conducted in July 2013 and January 2014 focusing in the open sea of the Brunei Bay within 5-25 km off the coastline of Sabah and Sarawak covering an area of approximately 500 km^2 (stations A1- A9 and T1 – T34 in Figure 1). The details about the sampling are given in Table 1.

Surface water samples were collected using 2.5 L pre-cleaned amber glass bottles with polytetrafluoroethylene (PTFE) lined screw cap. Duplicate samples were collected for replicate analyses. The experimental procedure of the analysis was based on the APHA method 5520B (APHA, 1995). Briefly, 1 L seawater was extracted there times with dichloromethane (total volume 100 mL) using liquid-liquid partition method immediately within 4 hours of sampling. The extracts were then combined