

D-4 Study on the effect of the oil spill to the marine environment in the Persian Gulf

Contact Person Yoshifumi Yasuoka, Section Chief
Information Processing and Analysis Section,
Social and Environmental Systems Division,
National Institute for Environmental Studies
16-2 Onogawa, Tsukuba, Ibaraki 305, Japan
Tel +81-298-51-6111(Ext.415), Fax +81-298-51-4732

Total Budget for 1991-1993 65,787,000 Yen (FY1993; 12,013,000 Yen)

Key Words Persian Gulf, oil spill, marine ecosystem, circulation, toxicity

Amount of spilled oil found in January 25, 1991 in the Persian Gulf was estimated by King Fahd University of Petroleum and Minerals as 3-4 million barrels. Along the coast of Gulf countries, there are many habitats of mangrove, coral reef and other wild life. Spilled oil ultimately becomes tar balls, and these tar balls will be drifted by Gulf circulation. Therefore it is anticipated to inflict enormous damage to marine ecosystem for long time of period. The objectives of this study are as follows; 1) develop the 3-dimensional numerical model including density, tidal and wind-driven currents in order to predict the behavior of spilled oil, 2) estimate the toxic effects of water-soluble fractions of crude oil on marine organisms, 3) develop the monitoring method of coastal ecosystem with satellite remote sensing.

The results of this study are as follows.

1. Three dimensional numerical model was developed. It was calculated that evaporative loss from the surface (av. $10 \times 10^8 \text{m}^3/\text{day}$) was supplemented by fresh water inflow from Tigris-Euphrates river (Shatt Al Araf river, av. $1.7 \times 10^8 \text{m}^3/\text{day}$) and surface inflow from Indian Ocean. The predicted patterns of drifted oil indicated that most spilled oil distributed along the coast of Saudi Arabia and off-coast of Saudi Arabia, which agree qualitatively with observation by U.S. coast guard and NOAA.
2. The meteorological and oceanographic observation data available for the area of Arabian Sea, Gulf of Oman and Persian Gulf were analyzed. Wind driven and tidal currents were simulated in order to predict the seasonal variation of flow field.
3. Main components in water-soluble fraction of Kuwait crude oil were analyzed. Highly volatile compounds like butanes, propanes, pentanes and hexanes were easily lost from seawater. Naphthalenes remained for a longer period. Water-soluble fractions had severe toxic effects on saltwater fish and prawn. Dibenzothiophene, which is one of organic sulfur compounds contained in crude oil, was found to remain in seawater for a long time. The bioconcentration factors of dibenzothiophene were 900 in red sea bream and 180 in prawn after exposure for 6 weeks.
4. Satellite imageries from NOAA AVHRR were collected and the extent of the area suffered from the smoke palls was evaluated. Also the field survey to collect ground truth data for the analysis of remotely sensed data was carried out at Jubail in Saudi Arabia. The collected spectral signature data showed the significant differences between the damaged coastal sand and the normal sand, and indicated the possibility of assessing the damages due to the War from remotely sensed imageries.