船舶事故性溢油污染應變策略之建議

The Effective Strategy of Oil Spill and Pollution in Ship Accidents

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壹、前言

2007年11月7日早上，中國租借韓國海運公司的「中遠釜山號」（Cosco　Busan）貨輪準備離開舊金山灣時，不慎撞上海灣大橋橋墩，船身撞出30米長的裂縫，不到半小時，58,000加侖的燃油洩漏到海水中，導致保育沼澤地遭受嚴重污染，魚群及鳥類大量死亡，進而重創當地觀光、漁業及經濟發展[1]。同年12月7日，滿載26萬公噸原油的香港籍「河北精神」號（Hebei　Spirit）油輪，在駛入南韓西岸大山港時，與一艘載起重機駁船發生碰撞，「河北精神」號左側出現3個大洞，1萬餘噸原油如「瀑布」般洩漏出海，綿延達5公里、直徑500公尺，且不斷擴散，造成當地超過154甲的牡蠣養殖場全都遭到燃油淹沒，養殖業、漁業及觀光事業受到嚴重衝擊[2]。

I、foreword

On the morning of November 7, 2007, China-rent container ship Cosco Busan navigated by South Korea marine transportation company crashed into the Bay Bridge suddenly as it leaved the Port of Oakland. The body of the ship was scratched for 30 meters long on one side. Within a half hour, 58,000 gallons fuel oil poured from the gash and flowed into the sea. The devastatative accident caused serious pollution in the reserved wetland areas, killing large numbers of fish and birds and damaging the local tourism, fishing and economical development.

In the same year, a Hong Kong registered crude carrier Hebei Spirit carried 260,000 tonnes of crude oil. As it sailed to the Port of Daesan on the west coast of South Korea, it collided with a crane barge being towed by a tug on December 7th. The collision punctured three holes on the left side of Hebei Spirit and resulted in the leaking of more than 10,000 tonnes of oil. The oil slick continually extended to 5 km long and diameter 500 m in some areas. The oil spill spread to devour 154 armours of oyster breeding farms in local areas. It is believed that the accident seriously destroyed local cultivation industry, the fishery and tourism business.

近數十年來，國際間不斷發生海洋污染事件，絕大部分來自於人為因素，嚴重的後果及清除工作也必須由人類自行承擔，因此，聯合國或國際海事組織（International Maritime Organization ,IMO）對於海洋環境的保護極為重視，並實踐在相關規範中；反觀國內，對於海洋環境保護之觀念係於近幾年才逐漸建立，雖民國89年通過「海洋污染防治法」，卻仍無法阻止後續發生的重大海污案件，如89年「阿瑪斯」號（Amorgos）墾丁溢油事件、94年「聖荷兄弟」號（Samho Brother）新竹外海溢漏液態苯事件及95年「吉尼」號（Tzini）蘇澳近岸溢油案等，雖溢漏數量與國際間重大案例相比不足為奇，且事後相關政府與民間單位均投入大量人力與機具進行清除，然成效極為有限，對於週邊海域及海岸生態、人類生活及經濟活動已造成難以彌補的浩劫。

In recent decades, oil spill and ocean pollution occurred continuously. Most of the accidents come from human factors. People are definitely responsible for the serious consequence and cleanups; therefore, United Nation and International Maritime Organization, IMO, greatly emphasize on the protection of ocean environment and reinforce the relative regulations.

As for domestic regulation, the concept of protecting ocean environment has been gradually developed just in recent years. Although “Marine Pollution Prevention and Control Law” was passed in 2000, ocean disaster cases are still unavoidable like oil spill of “ Amorgos “ in Kenting in 2000, product split of liquid benzene for “Samho Brother” in Hsinchu open sea and oil spill of “Tzini” in near Suao Harbor, etc.Although the numbers of oil spill and international significant cases are not so different, related governments and private enterprises donated massive man force and equipments for cleanups. However, the effect is extremely limited. It is believed that the disaster has caused the precedent catastrophe to peripheral sea areas, seacoast ecology, human life and economic activities.

Ⅱ、the change and damage of oil spill and pollution

(Ⅰ).The Change of Oil Spill and Pollution

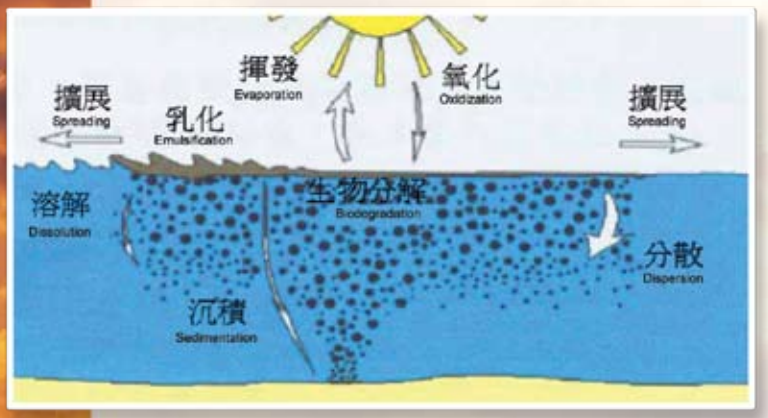
After oil is released into the ocean or coastal waters, a series of weathering process will be occurred, including sea level proliferation, volatility, oxidized, biolysis, dissolved, disperser, emulsified as well as seabed deposition. At first, thicker film of oil usually shows black color. After the emulsification, the color turns brown, orange or yellow color; but thin oil shows bright bands of color or silvery sheen. The change of oil possibly proceeds for several hours or several years. Each evolved stage of oil toxicity and the influence respectively

貳、船舶溢油污染之變化及影響

一、溢油污染之變化

原油溢入海面後，將歷經一連串風化過程，包括海面的擴散、揮發、氧化、海中的生物分解、溶解、分散、乳化以及海底的沉積。起初，較厚之油污通常呈現黑色，乳化後則變成棕色、橘色或黃色，而稀薄的溢油則呈現耀眼或閃銀光的狀態。溢油之演化可能從數小時到數年，而各演化階段（如圖1）之油污毒性及影響程度亦各有不同。

圖1：
chart 1:



漏油初期高揮發性之成份快速蒸發，強大風速、大浪亦會加速蒸發速度，而各種油品所含成份不同，其蒸發速度亦有差異（如表1）。

表1：各類油品揮發量比較

油品種類	12hr揮發量	48hr揮發量	全部可揮發量
汽油	50-100%	100%	100%
柴油	10-40%	25-80%	100%
原油	5-15%	10-25%	35%
重油(燃油)	1-3%	5-10%	15%
瀝青(API<10)	0-2%	1-5%	10%

資料來源：International Tanker Owners Pollution Federation Ltd-Technical Paper

show the difference (illustrated as chart 1).

The ingredient of the oil leak in the initial period has high volatility. The great wind speed and big wave can accelerate the evaporation velocity. Each kind of oil quality contains different ingredients and its evaporation velocity also has the difference (for example table 1).

Table 1:The Volatility Volume of Oils

Types of Oils	12hr Volatility Volume	48hr Volatility Volume	All Volatility Volume
gasoline	50-100%	100%	100%
Diesel	10-40%	25-80%	100%
Crude oil	5-15%	10-25%	35%
Fuel oil	1-3%	5-10%	15%
Asphalt (API<10)	0-2%	1-5%	10%

Resource Information: International Tanker Owners Pollution Federation Ltd-Technical Paper

Additionally, heavier oil quality has chemical emulsification with perfect harmony to form the shape of “chocolate muse”, so that the increased volume changed nature of the dirty oil and increased the difficulty of cleanups.

(II).Oil Spill and Damage of Ecology and Economics

The toxicity of the leaking oil from ships, no matter floating on the sea, drifting to the seacoast, depositing down to the sea bottom or whatsoever,is harmful to the plankton, fish, shellfish, birds and other wild animals and plants in the ocean environment. The floating oil isolates the sufficient light of sea for seaweed to drive photosynthesis. Therefore, sea water-soluble oxygen will be reduced. Marine lives will be more inevitably to leave the

另外，質量較重的油品以類似「水乳交融」般地乳化，而形成「巧克力慕斯」狀，以致污油體積增加量，並改變污油之性質，大大提升油污處理之困難度。

二、溢油污染對生態與經濟的影響

船舶溢漏的油污，無論浮在海面、漂至岸際或沉積海底，其毒性均對海洋環境中的浮游生物、魚、貝類、鳥類及其它野生動植物造成傷害。[3] 其中浮油具隔離性，會阻礙藻類的光合作用並使海水溶氧量降低，導致海洋生物被迫遷移，影響生態平衡；而溢油囤積岸邊，將嚴重破壞海濱生物、景觀、海岸工程或其它休閒設施，甚致人類透過食物鏈不知不覺中食用到受油污染的魚、蝦、貝類而危害健康。另外，事故性船舶漏油後續之清除工作，所付出的社會成本往往不容小視。

local marine environment and ecological system has been destroyed. In addition, it will also damage the seashore lives, the landscape, the coastal engineering or other leisure facilities and the food chain. It is poisonous for human's health to unconsciously take in those polluted fish,shrimps,shellfishes. Moreover, oil cleanups in the accidents should be paid with large social cost.

Ⅲ.Oil Spill Pollution Prevention and Control Regulation and Measure

(Ⅰ) The International Convention

The internarional society signed a norm to prevent harmful substances from being discharged into the sea by ships because of accident, mis-operation or intent. It is mainly based on appendix 1, Regulations for the prevention of Pollution by Oil, of The United Nations Convention on the Law of the sea 1982 and The International Convention for the Prevention of Pollution from Ships 1973 as well as The International Convention on Oil Pollution Preparedness, Response and Cooperation, OPRC 1990 . Those include operation control of oil pollution prevention on case of collision or grounding,harbour nation control mechanism, response program to minimize oil pollution on oil tanker injury and regulation of establishment of area cooperation and support as well as information exchange.

(Ⅱ)Domestic Regulation

Though domestic laws do not show regulations for the prevention of Pollution by oil, some regulations have been included in "Marine Pollution Prevention and Control Law", "Sea Water Pollution Management Rule" and "Marine Environment Pollution Elimination Processing Means and Correlation Urgent Strain Plan" and so on. Those establish the antipollution equipment, the certificate inspection including ship stipulation, oil tank-

參、船舶油污染防治規範與措施

一、國際公約

為預防船舶因事故、不當操作或故意將污染物質排入海中，國際間訂有相關規範，其中針對事故性溢油污染之防治，係以1982年聯合國海洋法公約、1973年防止船舶污染國際公約（The International Convention for the Prevention of from Ships ,MARPOL 73）之附件1防止油污染規則（Regulations for the prevention of Pollution by Oil）及1990年國際油污染整備、應變及合作公約（International Convention on Oil Pollution Preparedness, Response and Cooperation ,OPRC 90）為主，其中包括碰撞或擱淺時防止油污染之操作管制、港口國管制機制、油輪船體受損時將油污減至最低之應變計畫及建立區域性合作援助與資訊交流等規定。

二、國內規範

國內雖無特別針對船舶事故性溢油污染防治制定專法，相關措施卻已隱含在「海洋污染防治法」、「海水污染管理規則」及「海洋環境污染清除處理辦法及相關緊急應變計畫」等相關規定中，包括船舶應設置防止污染設備、證書查驗與禁航規定、油輪操作手冊及相關訓、演練等預防措施，以及船舶油污染之應變編組、油污染防堵、清除等事故處理技術。

三、防治措施

船舶事故性溢油污染之防治，大致分為事前預防、事中應處及事後復原等層面，其中事前預防部分，應從船舶的適航性檢驗、人員操作管制、建立國際合作與資訊交流等方面著手；而事中之應處，應加強應變編組、作業、訓練及設備之建立；至於事後之復原，則需藉由政府對遭受污染的環境影響持續進行監控，並積極展開復育計畫與行動，以逐步恢復當地生機；另應全面估算該溢油事件對當地農、漁、環境、觀光等造成之經濟損失及處理成本，以向船東展開求償作業，作為後續環境復原之重要經費來源。

肆、結論與建議

由於各船旗國對所屬船舶之安全管理與防污監

er operating manual and correlation training and prevention measures, as well as strain of grouping, the oil pollution, oil pollution guards, accident, and cleanups, etc.

(Ⅲ) Prevention and Control Measures

Preventions of oil spill by ship are approximately divided into three steps. Those are prevention, response and restore. The Prevention step includes ship equipment and facility, staff operation, international cooperation and information exchange. The response step is supposed to strengthen strain grouping, the work, the training and the equipment establishment. As for the restore step, public authorities needs to carry on the monitoring and positively working on restoring plans and actions for local ecological environment. In addition, it needs to estimate the damage of local agriculture,fishing, environment, tourism by oil spill comprehensively. The solution is to ask for compensation from the ship owners and the received payment is used as important expense for restoring polluted environment.

Ⅳ.Conclusion and Suggestion

Since safety control and monitoring prevention mechanism are different between countries and ship owners use Flag of Convenience in order to decrease operation cost and increase competition capability. The situation makes Taiwan peripheral sea area expose to navigation safety danger and even face oil spill by ships.

Regarding prevention for oil pollution by ship, the author briefly indicates suggestions as follows:

(Ⅰ)Positively Realize Our Harbor Prevention Work plan

Tokyo's Report Memorandum states that in Asian and Pacific area, harbor country control based on international convention, international marine safety and antipollution has mechanism for

督機制參差不齊，以及船東為減低營運成本及提升競爭力而相繼使用權宜船（Flag of Convenience；FOC）等情勢，使台灣周邊海域暴露在航行安全堪慮的狀態下，進而衍生事故性海污案件。

環視國際間對於船舶污染防止之成果，筆者對於國內海洋污染防治工作，簡單提出以下建議：

一、積極推動我國港口國管制工作

目前亞太地區港口國管制之東京備忘錄各締約國，依據國際海事安全及防止污染等公約規定，對於外國船舶具有檢查、扣船等機制，有助於防止船舶油污染之發生[4]；反觀國內，雖於91年12月20日正式公告，自92年起實施港口國管制檢查，並依據國際海事組織所定港口國管制相關規定[5]，然迄今因未轉換成為國內法，且港口國管制官員培訓制度尚不健全，加上國際政治現實因素暫無法加入東京備忘錄等區域型港口國管制組織，故施行成果有限，對於航行於我海域之次標準船較無嚇阻效果，徒增船舶污染之可能性。

inspection and holding to prevent oil pollution; As for domestic regulation, the public authorities proclaim the implementation of harbor country control inspection in December 20th, 2002. Since 2003 , according to the harbor country control law, reinforce of the regulation has been realized. However, the law hasn't been transformed to internal laws. In addition, the training program of harbor country control is not sound. International political factor is not able to be included in Tokyo's Report Memorandum. For the limitations of the realization, the prevention to the sub-standard ship is less effect. The possibility of the pollution is still increased.

Therefore, the government should accelerate the legislation of transforming international ship pollution prevention laws into domestic regulations. The purpose is to cooperate with advanced countries about ocean events and increase the training of harbour officers. Even if we can't join in relative international organization successfully, we should make all efforts to develop the platform of exchanging information with neighbour countries. It is to upgrade working efforts of harbour inspecting and decrease the possibility of oil spill accidentally or purposely.

(II)Integrating pollution Cleanup Response Capacity

Nowadays, Coast Guard Administration is the main agency in response to domestic oil spill. Coast Guard Administration exclusively reinforces Sea Area law, Maritime Affair Service and other tasks. Pollution prevention and control is only a little part of its tasks. Coast Guard Administration has four pollution cleaning ships, various types of oil ropes, oil absorber and relative greasy dirt equipments; however. Most of these equipments are budgeted and purchased by Environmental Protection Administration and transferred to Coast

因此，政府除應加速立法，將國際上防止船舶污染相關規範轉化成為國內適用之法規外，更應持續與相關海事先進國家合作，加強港口國管制官員之培訓，另雖無法順利加入相關國際組織，仍應竭盡所能與鄰近國家建立交流機制與資訊交換平台，以提升港口國管制檢查工作之效能，減少事故性溢油或故意洩油事件之發生。

二、整合除污應變能量

目前國內係由海巡署擔任主要海洋油污染緊急應變執行機關，惟海巡署依法肩負海域執法、海事服務等各項任務，污染防治僅佔一小部分，雖其現有4艘除污平台船、各型攔油索、汲油器等相關油污設備與器材，然大部分皆由環保署每年編列預算購置並移撥海巡單位使用，並未全然符合實際所需。

因此，海巡署應可成立一專責單位，擔負海污執法、取締、應變處理等工作，並建置區域海洋污染應變協調整合中心，迅速整合、調度各區域應變資源及落實除污設備管控與維護，以利縮短突發狀況處理時間。

三、加強人員除污應變訓練

環保署雖每年舉辦國內、外專業除污訓練，但各單位部分薦舉人員非實際參與或主管者，使訓用合一之效果打折。

因此，國內可參考加拿大海岸巡防署作法，由環保署召集專家學者或曾出國受訓之人員，研究編製溢油應變野外指南等隨身手冊，供處理人員隨身攜帶參用。

四、建立完善的污染環境監測機制

阿瑪斯號墾丁溢油事件在我國政府於挪威Arendal法院展開跨海訴訟求償官司後，雖判決船東有賠償我環境損失之義務，但核給的金額扣除我方所付之相關費用，竟仍須自行負擔新台幣734餘萬元損失，而該項金額僅係船難初期我方已實際支付之監控費用，至於我方請求之珊瑚、漁業復育費及觀光與稅收損失等等，則因該法院認為我方無法具體證明該事件對於上開費用及損失之直接關聯而無法獲償。

因此，國內對於重要保護地區應先建置完整生

Guard Administration every year. However, it does not fully match the requirement.

Therefore, Coast Guard Administration should establish a sole responsibility unit to perform marine pollution relative laws enforcement and response tasks.Additionally, it has to establish the regional marine pollution strain response and coordination center to rapidly integrate and manage regional response resources as well as to fulfil pollution elimination equipment control and maintenance to curtail emergency response time.

(Ⅲ) Reinforce Training Program of Oil Cleaups

Environmental Protection Administration holds domestic or foreign training, but part of recommend staff doesn't practically participate or take charge of de-pollution business and curtail the effect of combining training and practice. Therefore, we may refer to the program of Canadian Coast Guard Administration. Experts and staffs once trained abroad can be convened by Environmental Protection Administration to edit Oil Spill Response Manual for related staff's reference at hand.

(Ⅳ) Development of Sound Environmental Monitoring Mechanism

The local court in Arendal, Norway announced its verdict, concerning the oil spill caused by the grounding of a cargo ship Amorgos in Kenting. The arbiter had compensation compensates duty belonged to ship owners, but we still responsible for more than NT $ 7,340,000 after the compensation being deducted for our relative payment.Also, the compensation amount can only pay the monitoring expenses in the early stage of the disaster. To the losses of coral and fishery restoring, tourism and tax, the court regarded that we didn't have specific proof in this accident so we were unable to own the full expense and payment.

Therefore, our government should initially work on complete records and documents

態、產業等基本資料，倘發生重大海污事件，則應立即啟動廣泛的環境監測機制，以證明該事件所帶來的實際損害數據，對於我國在國際法庭展開之後續求償工作，將有莫大助益。

（本文作者任職於海巡署巡防處）

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about our ecology and industry. Once we encounter a serious accident, we can instantly use a series of environmental monitoring mechanism. The purpose is to show the specific data about the pollution and damage. Then, it will definitely help for the following compensation demand in the international court.

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