出國報告（出國類別：開會）

參加國際油田化學研討會與探勘/生產環境保護與安全研討會

服務機關：台灣中油公司 探採研究所
姓名職稱：林舜隆/環保師
派赴國家：美國
出國期間：96 年 2 月 27 日至 3 月 8 日
報告日期：96 年 5 月 2 日

參加國際油田化學研討會與探勘/生產環境保護與安全研討會

摘　要

本奉准因出國案，期間自 2 月 27 日起至 3 月 8 日止，主要目的是參加由美國石油工程師學會(SPE)所舉行「International Symposium on Oilfield Chemistry」及「E&P Environmental and Safety Conference」二項研討會，藉以學習研討油氣鑽探/生產過程之監測、腐蝕、水合物、結垢、鑽井泥漿等各種鑽井/完井化學問題處理及工安與環保相關議題，同時於會中發表本公司研究成果論文－「An Innovative Utilization of Drilling Wastes as Building Materials」，宣達中油公司於鑽井廢棄物資源化之研發成績，並與相關專家學者研討。

有鑑於近年來台灣地區許多油氣層正面臨蘊藏量枯竭所衍生的問題不斷，因此鼓勵參與相關會議，派員訓練增長技能，以因應現場需求是迫在眉睫的課題，也是長久經營之必要；而面對台灣陸上油氣枯竭的困境，建議研發激勵生產，提高採收率的技術，或可為一新的契機。在油價高漲、全世界對於環境議題日益矚目的情況下，身為台灣最大能源供應者的中油公司應更正面、積極、遠瞻的處理環境問題，以降低生產成本，增加獲利，開發替代能源，提升環境友善技術，是中油責無旁貸的企業責任，也是中油永續發展的方向之一。

參加國際油田化學研討會與探勘/生產環境保護與安全研討會

目次

壹、目的

本出國案主要目的是赴美國休士頓參加由 SPE(Society of Petroleum Engineers,美國石油工程師學會)所舉行「International Symposium on Oilfield Chemistry」及「E&P Environmental and Safety Conference」二項研討會，藉由參與「International Symposium on Oilfield Chemistry」會議之機會學習研討油氣鑽探、生產過程之監測、腐蝕、水合物、結垢、鑽井泥漿等各種鑽井/完井化學問題處理，以因應未來配合現場需求進行鑽井泥漿、井管防蝕及酸處理等研究，另於「E&P Environmental and Safety Conference」會中發表本公司研究成果論文－「An Innovative Utilization of Drilling Wastes as Building Materials」，宣達本公司於廢棄物資源化之研發成績，同時藉由研討瞭解有關鑽探/生產過程中所產生各類環境、工安問題之先進技術。赴美國休士頓期間並至 KAPPA North America, Inc.公司，研討並瞭解油氣鑽探相關軟體及未來趨勢。

貳、過程

本次出國行程如表1所示。96年2月27日搭機至美國休士頓，自2月28日起至3月2日為期3天，參加第一場會議：「International Symposium on Oilfield Chemistry」，會議全程於Woodland的The Woodlands Waterway Marriott Hotel & Convention Center舉行，過程除參與會議，聽取相關研究論文、實際經驗發表外，亦參觀於會場參展之儀器設備、軟體等產品並交換資訊；第二場會議：「E&P Environmental and Safety Conference」則自3月5日起至3月8日於Galveston的The San Luis Resort舉行，參與會議除聽取發表外，並於3月5日會場議程中口頭發表中油公司研究成果論文－「An Innovative Utilization of Drilling Wastes as Building Materials」，宣達中油公司於廢棄物資源化之研發成績，並與相關專家學者研討。出國期間並利用3月3日、4日二天參訪KAPPA公司位於美國休士頓之分公司，研討、學習該公司在油氣探勘/生產等相關領域之工程軟體的產品及功能。行程於3/7日晚間搭機返國。

表 1. 出國行程表

日期	工　作　內　容	地　　點
2/27	啟程	苗栗-美國 休士頓(市區)
2/28-3/2	參加「International Symposium on Oilfield Chemistry」	休士頓(Woodland)
3/3-3/4	參觀 KAPPA North America, Inc.	休士頓(市區)
3/5-3/7	參加「E&P Environmental and Safety Conference」	休士頓(Galveston)
3/7-3/8	返程	美國 休士頓-苗栗

參、心得

此次出國期間參加由SPE所舉行「International Symposium on Oilfield Chemistry」及「E&P Environmental and Safety Conference」二個研討會，並參訪 KAPPA North America, Inc.公司瞭解油氣探勘/生產相關工程軟體，茲將所參與各行程所得分述於下：

一、參加「International Symposium on Oilfield Chemistry」會議

本次在休士頓舉行的「International Symposium on Oilfield Chemistry」是第 21 屆，自 2 月 28 日起至 3 月 2 日為期 3 天中，共有 11 個場次的口頭發表及專題演講(參見表 2)，有 90 餘篇報告，其中包括各種關於能源生產的基礎理論研究成果、實務問題解決及現場案例呈現等，所探討的主題有：鑽井及完井(Drilling and Completions)、水泥封固及液裂的發展(Advances in Cementing and Fracturing)、藉由激勵增加油氣生產(Oil and gas production enhancement by stimulation)、氣體及生產水控制與增進油回收技術(Gas and water production control and enhanced-oil-recovery techniques)、維持流動的問題解決:包括水合物及無機物的預防與管理 (flow-assurance solutions including prevention and management of hydrates, inorganic scale prevention and management)、有機物固體沈澱(organic solids deposition)及乳化液

-蠟、柏油與環烷酸(emulsions – waxes, asphaltenes and naphthenates)等。由於全場會議發表的論文範疇甚為廣泛且場次眾多，因此筆者於會議過程僅能選擇部分與目前工作相關之議題參與，學習研究其觀念與技術，茲將部份所參與議題內容摘要分段敘述如下：

表 2　International Symposium on Oilfield Chemistry 場次議題程序表

日期	時間	會場	場次議題
2/28	8:30-12:00	Waterway 1-2	Drilling and Completions
	8:30-12:00	Waterway 4	Wax and Asphaltenes
	13:30-17:00	Waterway 1-2	Advances in Cementing and Fracturing
	13:30-17:00	Waterway 4	Naphthenates, Emulsions and Chemical Delivery
3/1	8:15-11	Waterway 1-2	Water Treatment and Biochemical Solutions
	8:15-11	Waterway 4	Production Enhancement – Improved Oil Recovery and Stimulation
	13:45-17:15	Waterway 1-2	Reservoir Souring–Do Nitrates Work?
	13:45-17:15	Waterway 4	Flow Assurance and Hydrates
3/2	8:30-12:00	Waterway 1-2	Water and Gas Control
	8:30-12:00	Waterway 4	Scale Prevention and Management

圖 1 International Symposium on Oilfield Chemistry 會議會場

圖 2 International Symposium on Oilfield Chemistry 議題會議室

圖 3 International Symposium on Oilfield Chemistry 會議參展儀器設備

對鑽井工程而言，泥漿具有舉足輕重的地位，是否能夠調配出適當性質的泥漿，對於整體的工程進行是否順利影響甚鉅。在本次研討會發表中，即有不少對於鑽井泥漿選擇、使用及改善等方面之論述，例如其中有利用矽基泥漿以降低金屬腐蝕的探討(Use of Silicate-Based Drilling Fluids To Mitigate Metal Corrosion , M. McDonald 等人)，發表作者以在加拿大西部實際應用矽酸鉀基鑽井泥漿的研究案例，說明以矽酸鈉及矽酸鉀的化學特性保護金屬材質不受腐蝕損壞，此外在鹼性環境中，矽酸可在各種金屬材料表面沈澱形成保護膜，因此更可強化其防蝕。其他另有如水基鑽井泥漿在高溫/高壓環境中應用的探討(Water-Based Drilling Fluid for HP/HT Applications, M.A. Tehrani 等人)，在鑽井過程中，泥漿乳化作用對於地層層污損之形成原因 (Formation Damages Caused by Emulsions During Drilling With Emulsified Drilling Fluids, Ingebret Fjelde 等人)，氧化作用對於油基泥漿與合成泥漿流變修整、造成劇變的潛勢探討(Oxidation as a Rheology Modifier and a Potential Cause of Explosions in Oil and Synthetic-Based Drilling Fluids, K. Shahbazi 等人)。

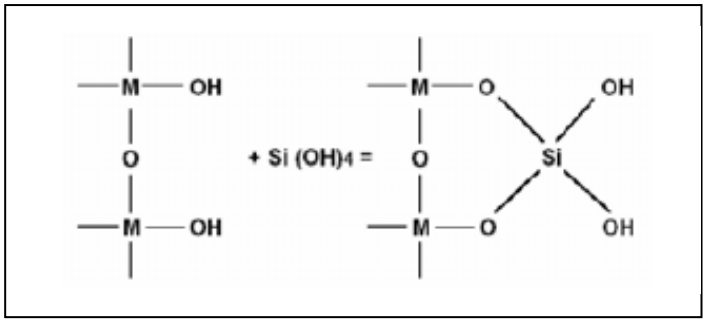

圖 4 矽酸鹽在金屬表面的沈積

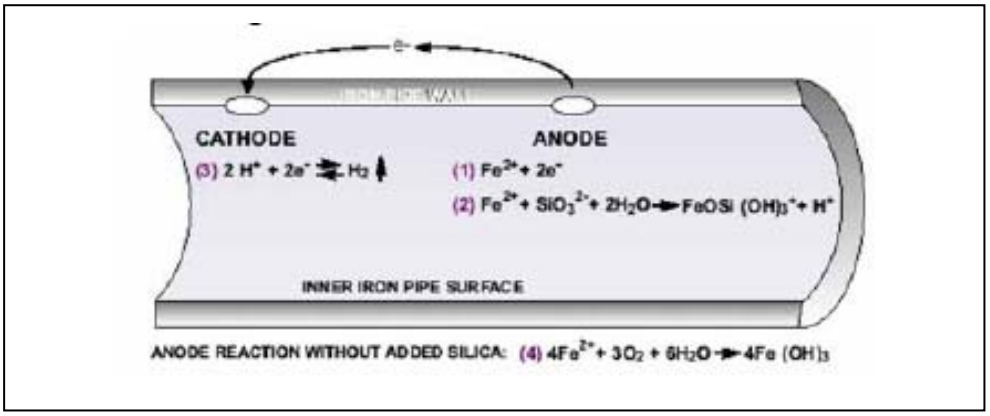

圖 5 含矽酸鹽及不含矽酸鹽之水基泥漿中，鐵的腐蝕化學反應示意

另有以微膠粒子進行儲氣井堵水的實際經驗(Using Micro Gels to Shut Off Water in a Gas Storage Well, A. Zaitoun等人)，在作者發表中描述，該技術是結合實驗室的岩心浸沒試驗及由鄰近區域鑽孔所得儲氣層模擬結果進行設計，該團隊在2005年6月時，以鑽鑿在砂岩儲氣層結構的試驗井(裸孔完井)進行試驗，過程選擇使用粒徑約 2μm 的微膠粒子，將微膠粒子填置於主要產水的薄高透水層區塊(位於高透水層的底部)，由於壓力的限制，整個處理體積僅26m^3，此後

再以氣體逆沖排到氣體可注入性恢復，經過處理後產水顯著的減少，產氣率增加，再經模式模擬預測井況良好，證實堵水成功。

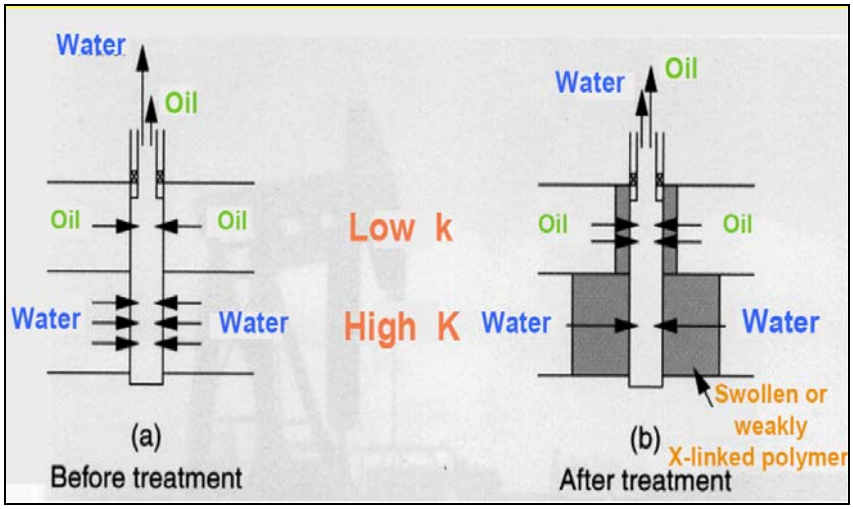

圖 6 生產井堵水處理原理示意圖

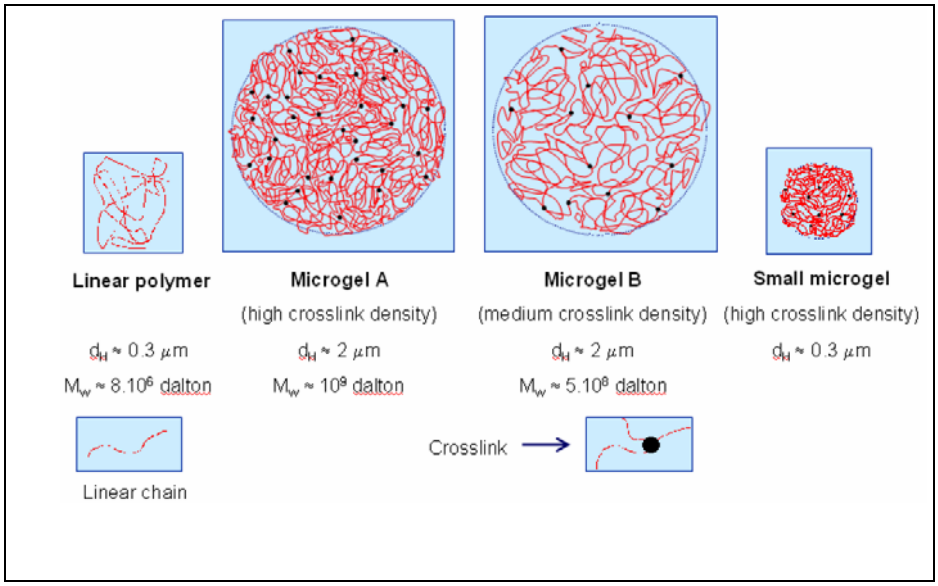

圖 7 聚合物及完全水解微膠體種類

二、參加「E&P Environmental and Safety Conference」會議

本次於休士頓 Galveston 島所舉行 SPE 探勘及生產環境與安全研討會係為第 8 屆，會議探討主軸在油氣探勘/生產工業中的環境問題與安全管理，研討會自 3 月 5 日起至 3 月 7 日連續舉行 3 天，議程中包括 3 場大會主題討論、2 場專題演講及 10 個場次的口頭發表，其中包括專家學者的研究成果、現場實績經驗的分享與學生的研究論文等，共有 55 篇文章刊錄在研討會議程中。

3 場大會主題討論題目包括：溫室氣體(Greenhouse Gas)、工安領導階層作為(Safety Leadership)及受颶風襲擊後，在墨西哥灣區受到影響的產油設施，災後所面臨的挑戰(Challenges of Post Hurricane Decommissioning in the GOM)。在 3 月 5 日會議開幕後的第一場大會主題討論，是溫室氣體議題，由 Michael L. Godec 主持，Vello Kuuskraa, Michael Moore, Steve O'Connell 及 Carl Wirdak 等人主要參與議論，會議中談論近年來受到矚目的全球氣候持續變化，以致於全世界各國將溫室氣體排放控制列為主要的改善計畫，且這項方案將不可避免逐漸擴大、嚴格，許多國家更將訂定法律加以規範，而此趨勢將對油氣探勘/生產工業產生相當的衝擊，許多政府基金提供資金鼓勵較前瞻性的工業以抑制溫室氣體的排放，但如此作為的同時，也造成增加油氣生產量與減少溫室氣體排放間的矛盾，對於

是否持續供應廉價的碳氫燃料在未來必將面臨爭議與討戰，參與討論的專家提出許多油/天然氣公司在這種趨勢下的所扮演的角色、石油工程師如何在石油工業中有效的減少溫室氣體排放、以及藉由工業操作將二氧化碳永久隔離在油/氣田或其他地質結構中，這些對溫室氣體減量都是具有重大意義，而對於台灣目前面對二氧化碳減量公約衝擊，乃至中油公司未來如何積極因應二氧化碳減量政策，深具啟發價值。

而接續的第二場大會討論即為關於工安領導階層作為的議題，由 Rennie Heath 主持，Frank Perry, Mike Thompson, Ian Sutton 等人與談，會中談論到石油及其相關工業中，傑出的工安領導階層如何積極的建立公司的安全作業基準，提供安全環境、作業安全在石油工業中對經營者的重要性、為達到工安保障及財務兩全，在執行管理上關鍵性要點等議題，同時與會專家也提供了解決工安問題的技術、工具與策略上的管理方法。另外在 3 月 6 日下午的第三場大會討論，探討在 2005 年受到卡崔納(Katrina)及芮塔(Rita)等颶風襲擊後，在墨西哥灣區受到影響的產油設施，災後所面臨的挑戰。根據 MMS(Minerals Management Service)統計，在墨西哥灣的海上產油/氣設備中，4000 個海上平台中有 76%、33000 海哩的管線中有 73%是直接暴露在一個或二個颶風侵襲的路徑中，而颶風侵襲毀滅了 115 個平台，損壞了

52 個平台，輸油管線有 535 處毀損。會中描述在颶風襲擊後，墨西哥灣的這些產油/氣操作者正面臨災後重建的各項挑戰，並且檢討、提出各項建議。

表 2 「E&P Environmental and Safety Conference」場次議題程序表

日期	時間	會場	場次議題
3/5	8:30–10:00	Grand Ballroom A&B	Plenary Session I – Greenhouse Gas
	10:30 12:00	Grand Ballroom A&B	Plenary Session II – Safety Leadership
	13:30-17:00	Windjammer Room	Safety and Environmental Management I
	13:30-17:00	Elissa Room	Site Issues
	13:30-17:00	East Mainsail Room	Student Papers
3/6	8:30-12:00	Windjammer Room	Safety and Environmental Management II
	8:30-12:00	Elissa Room	Produced Water
	8:30-12:00	East Mainsail Room	Culture
	13:30-15:00	Windjammer Room	Transportation
	13:30-15:00	Elissa Room	Panel I - Impact Of Oil & Gas Activity on Marine Environments
	13:30-15:00	East Mainsail Room	Panel II - Safety Integrity
	15:30–17:00	Grand Ballroom A&B	Plenary Session III – Challenges of Post Hurricane Decommissioning in the GOM
3/7	8:30-12:00	Windjammer Room	Community/SD
	8:30-12:00	Elissa Room	Waste
	8:30-12:00	East Mainsail Room	Safety at Work

此外，在 3 月 6 日的議程中並安排 2 場分組專題演講，分別講述有關油/氣探勘生產活動對海洋環境的衝擊與如何落實工業安全相關議題。

參加本研討會除聽取相關研討、成果發表及演講外，並在研討會議程中發表中油公司近年來在鑽井廢棄物資源化再利用的研究成果，於此摘要說明本研究成果，同時對各研討會場次發表文章中有關助目前工作者，摘取部份敘述如下。

成果發表：「An Innovative Utilization of Drilling Wastes as Building Materials」，本計畫是以中油公司近年來在台灣地區油氣鑽探過程所產生鑽井混合廢棄物為對象，進行廢棄物資源化可行性研究。考量廢棄物之性質、技術可行性及產品市場，本計畫於實驗室利用鑽井廢棄物進行建築用普通磚、部分取代混凝土及透水磚等資源化產品之產製與試驗。試驗結果顯示，鑽井廢棄物之資源化可朝製作成透水磚、建築用普通磚等產品方向著手，另外在添加輔助材料及適當條件下亦可部份取代水泥作為混凝土材料。而由於鑽探期程、添加泥漿等條件的差異，也反應出鑽井廢棄物若干性質的不同，其間也影響到廢棄物資源化再利用的用途，因此未來鑽井廢棄物應依鑽鑿期程、泥漿添加、地質變化等分階段予以儲集處理，以利於後續之資源化再利用，降低處理成本與風險。

圖 8 利用鑽井廢棄物資源化製作建築用普通磚試體磚成品

圖 9　利用各鑽井廢棄物燒製成之透水磚成品

另有與本研究相似的成果發表，其將海上鑽井鑽屑加入柏油中混合，做為道路舖面材料(The Development and Trial Use of Oil Exploration Drill-Cutting Waste as an Aggregate Replacement in Cold-Mix Asphalt, Bob Allen 等人)，此研究成果結合產出鑽屑的鑽井單位、道路管理單位與柏油生產單位的技術合作。研發過程添加 20%的焚化底灰藉以增加混合物的孔洞結構，使其可以包容鑽屑的高含

圖 10 研討會研究成果發表現場

圖 11 與其他與會專家研討合照

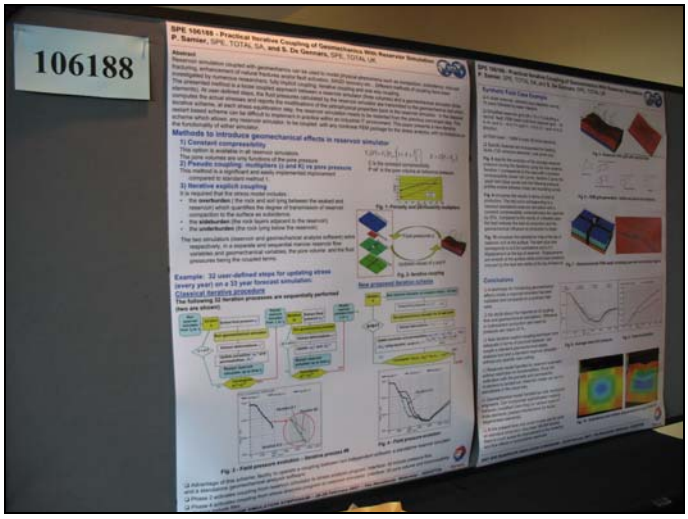

圖 12 研討會壁報發表會場

水率，以黏結低黏度的油，整個計畫包括土方場/工廠的實驗室研發試用，經過實場生產評估及最後的應用。這個程序證實不但可有效減少海上鑽探所產生的廢棄物，且符合環境安全性。此研究之處理對象與中油公司目前正積極研究處理的鑽井廢棄物甚為相似，因此其成果對中油公司而言深具參考價值。

而在Jacquelyn F. Star等人所發表的「Application of Innovative Chemical and Mechanical Processing for Treatment of Difficult Production-Waste Sludge」中，則以印尼的Kalimantan為案例，描述其團對處理長久來一向難以處理的油槽(桶)、油輪等累積的底泥、油泥、乳化油、結合金屬氫氧基的皂化物和各種混合砂土、臘質混合物；以往該類廢棄物的處理隨習慣經驗、使用範圍、當時考量等從簡易的開放式燃燒、土地散佈到注入裂縫處理各有不同，但這幾種選擇從未考量將回收油、環境保護、法規等問題，本計畫中使用積極的熱處理、特殊化學去乳化沈澱與各種離心分離設備組合，證實能處理大部分的混合廢棄物泥，作者的團隊在Lawe and Santan Terminals成功轉化了500,000桶的廢棄物泥，最近更在Santan Terminal完成以高能光線處理了220,000桶廢棄物泥的實驗，其從試驗中完成關鍵設備組合、建立設計參數、處理速率及回收油的最佳化、移除砂粒等固態物和處理成本評估，結果證明此處理程序可以提供商業化、兼顧成本

及環境保護的處理。

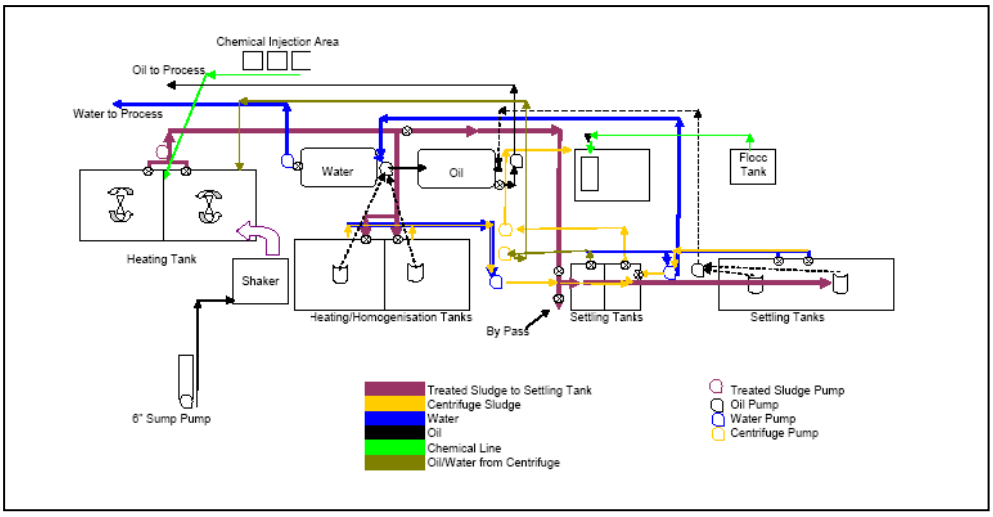

圖 13 油泥混合廢棄物處理流程

除了對於鑽井廢棄物減量、資源化的相關研究之外，對於鑽井過程所產生廢水與地層水的處理與再利用亦有不少的成果發表，例如在重原油生產過程所產生伴產水與地面水的減量、運送、處理等控制與管理的研究(Environmental Challenges of Heavy Crude Oils: Management of Liquid Wastes, Jerry M. Neff)；George H. Holliday 以美國西部的油氣生產操作每年產生10億桶伴產水，評估分析若能將此伴產水去鹽化處理，使其可作為灌溉用水或飲用水，則其對水資源效用將大有幫助(A Need for Converting Produced Waters to Useable Waters)，而J.A. Veil 等人更在會中發表「Innovative and Interactive Produced-Water Information Resource」，介紹由阿岡國家實驗室 (Argonne National Laboratory) 所發展的網絡基礎伴產水

管理資訊系統 (web-based Produced Water Management Information System，PWMIS)以推廣積極有效的管理、運用油氣生產過程所產生的伴產水，使其成為寶貴的資源。

而其他有基於環境友善的鑽井泥漿應用研究、實績經驗發表，如M. Amanullah等人所發表，針對在水基泥漿中所使用的環境友善添加機篩選與評估(Screening and Evaluation of Some Environment-Friendly Mud Additives To Use in Water-Based Drilling Muds)，發表中談到，雖然基於環境因素，由含有害成份的油基泥漿轉而使用環境友善的水基泥漿越來越受重視，但由於傳統水基泥漿的工程實用特性差與熱穩定性低，因此常常被棄而不用。在其研究中即比較三種新的水基泥漿添加劑，分析描述其黏度控制、流體損失與熱穩定性，結果顯示其中最佳的一種新添加劑，對於基礎皂土泥漿可增加PV超過100％、YP增加超過400％，10秒膠體強度增加200％(150℃熱旋轉16小時後)。而Seyed Mohsen Samaei等人以在伊朗的實用經驗發表「The Possibility of Replacing Oil-Based Mud With the Environmentally Acceptable Water-Based Glycol Drilling Mud for the Iranian Fields」，其論述中也是以基於油基泥漿所衍生的環境問題，尋找適當無害的水基泥漿；而水基乙二醇泥漿由於具有頁岩抑制特性、環境可接受性及操作容易、高潤滑性質，越來越受到歡迎，

作者在伊朗油田以環境可接受性水基乙二醇泥漿替代油基泥漿，進行可行性探討，評估過程進行二種泥漿的流變試驗，並以乙二醇泥漿進行頁岩粒子(取自現場的鑽屑)的崩解試驗(以熱旋轉進行)，計算頁岩回收率，評估其頁岩抑制性質；經由實驗室試驗結果顯示，乙二醇泥漿可顯著降低黏土分散與鑽屑的水合作用，因此可被考慮作為油基泥漿的替代。

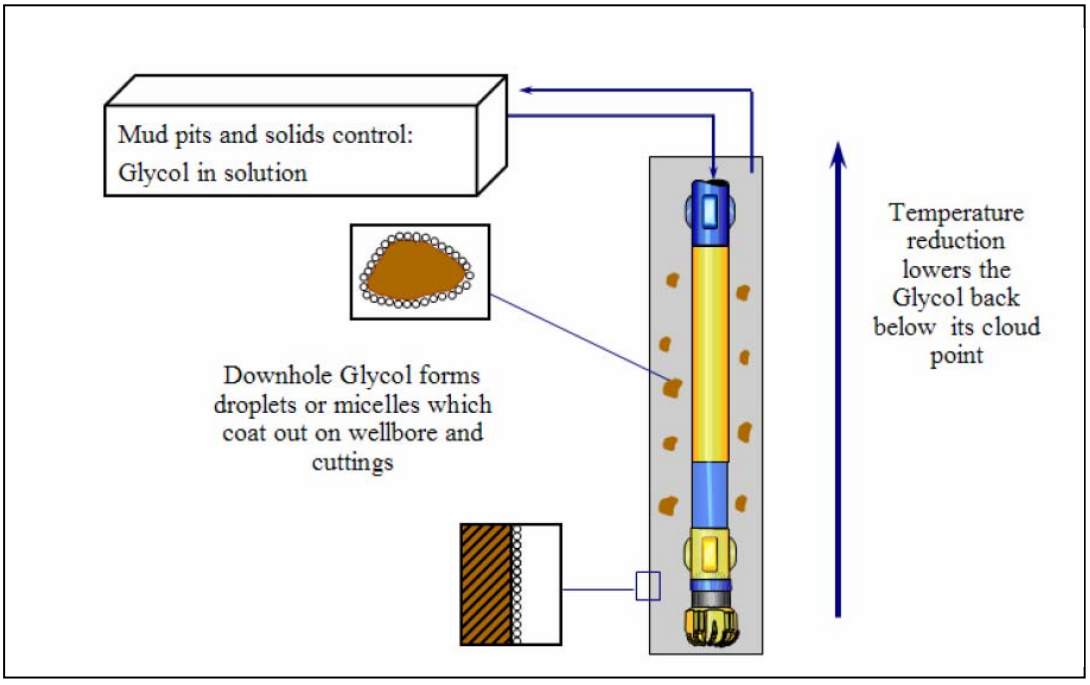

圖14 乙二醇泥漿的Cloud Point Activity示意圖

三、參訪 KAPPA North America, Inc.公司

本次赴美期間，趁二個會議議程空檔，於 3 月 3 日、4 日二天參訪 KAPPA 公司，學習瞭解該公司近年來在石油工程、油氣鑽探相關軟體的發展產品及未來趨勢。

KAPPA 公司建立於 1987 年，主要在研發石油工程相關軟體，目前總部設於法國的 Sophia Antipolis，而在全球 10 個國家設有分部據點，其主要產品為一整合型作業平台，可以進行流動動力學分析的工業標準軟體「Ecrin」，其內容元件包括：暫態壓力分析模式(Saphir)、生產分析(Topaze)及整合生產記錄分析模式(Emeraude)，此外另有二個軟體：節點分析模式及油層實場模擬模式。KAPPA 公司目前擁有超過 3000 個商業軟體執照，是經微軟公司(Microsoft)驗證的伙伴之一，全世界有 300 家公司以上使用過其產品；KAPPA 公司同時也提供其軟體相關配套訓練及諮詢顧問服務。

最初，基於現場顧客及人員需求，KAPPA 公司在單一環境下結合其數個應用軟體於成為一整合型的工程工具軟體-「Ecrin」，使其可大量節省工程師處理的時間，免除重複處理、繁瑣的輸入/輸出程序。在 2005 年，Ecrin 4.0 版僅單純結合三個模式去處理固定性的井底量測數據、數據管理(Diamant)、暫態壓力分析(Saphir 及 Saphir NL)和生產分析(Topaze)，2006 年 KAPPA 公司更新發行 Ecrin 4.02 版，

而為了更緊密連結 Ecrin，並在 Ecrin 模式處理相關數據，KAPPA 公司也研發了一個中央伺服器「Diamant Master」，使其可以處理常態固定性的數據及收集、過濾、分享井底量測數據和生產數據，Diamant Master 伺服器，是以在 Ecrin 內的 Diamant 模式進行操作。而在後來的補強中，另外增加在 Saphir 模式中整合最新發展的工業非標準程式，以及在 Topaze 模式內增強多井模擬功能。後來 KAPPA 公司也持續研發出 PA 模式的非線性版本(Topaze NL)，整合強化生產記錄分析軟體(Emeraude)、新的油層模擬(Rubis)和節點分析模式(Amethyste)。

由於油氣探勘/生產是結合複雜地質、物理、化學、機械等複雜的工程，所須耗費成本甚高，風險亦高，然其成功價值回饋也高，所以如何在先期探勘、生產操作等過程以適當軟體進行模擬預測，進而節省不必要的花費或避免意外產生，是絕對必要的；因此對於參考相關軟體的功能與發展現況，進而尋求、採用適當軟體進行模擬，對中油公司油氣探勘/生產作業而言，是重要的工作之一。

肆、建議

此次出國行程計畫中，同時參加了「International Symposium on Oilfield Chemistry」及「E&P Environmental and Safety Conference」二個由SPE所舉辦的研討會，由於二者恰好在相近的期間，均在休士頓地區舉行，以一次出國之機會同時參加二個會議，兼收兩者之精萃，所得豐碩，殊為難得。由參與研討會及參訪KAPPA公司過程中，學習到了不少石油工程相關新知與新技術，也讓視野更加開闊，獲得不少交流經驗，收穫匪淺，然而其中也有一些體悟與感想，茲以下提出數點建議，供以省思、參考：

1.近年來由於台灣地區現有陸上油氣蘊藏量日益減少，故不論在現有油氣層的生產或新油氣層的鑽探，都日漸困難；在現有生產的油氣井中，由於許多油氣層都已面臨可生產的末段，因此往往產生蘊藏量枯竭的許多問題，例如生產層出水，導致末端水處理問題、產氣減少、油管腐蝕、如何有效堵水？選用有效防蝕劑？...等相關問題，由於生產壓力降低導致生產量不足，如何激勵油氣層以增加產量？低壓生產問題；而在新油氣層的鑽探，由於必須鑽探深度日益增加，其所衍生的鑽井技術突破、耐高溫/高壓泥漿的選用...等，都是亟待解決的問題，因此如何尋求提升更新、更有效的技術以因應現場需求是迫在眉睫的課題，透過參與相關的研討會積極獲取新知/新技術

並交流分享經驗，是一經濟實惠的管道，且遠瞻於長久經營之必要，增進新技術的提升與創新，與世界新潮流接軌，公司應積極鼓勵參與相關會議，派員訓練增長技能。

2.在中油公司努力經營六十餘年，台灣地區現有油氣井在現行生產技術下，多數都已達可生產的末期，雖然近年來的策略重心在積極探勘新油氣層、開發蘊藏量，然而鑽探工作卻仍少有展獲，可尋得的新油氣層日益減少；在本次所參加的研討會議題中，有不少油氣田激勵生產，提高採收率的論述，咸認為以激勵、改善生產技術，延續、增加現有油氣井的採收，增加生產量，是一個值得發展的方向；以新探勘尋找新油氣層，估算其尋獲機率、花費成本、所耗時間、人力，即使可獲取新油層，然若其蘊藏量不夠大，效益未必高於在現有油氣井提升採收率的獲利，以台灣地區陸上油氣探採現況，若能使現有井增加數個百分點的可採收率，其效益或許即大於新油層的開發，對中油公司而言，或可是一條新的途徑。

3.不論在全世界或國內，對於環境議題的矚目程度日益著重，由本次參加的兩項研討會中可看出，從近來備受全球重視的溫室效應氣體排放控制議題，廢棄物質資源化觀念與技術提昇(例如伴產水再利用/管理、鑽井廢棄物資源化再利用)到環境無害技術的開發(例如對環境友善鑽井泥漿的應用、鑽探/生產廢水、廢棄物的處理、鑽探/生

產環境管理)，全球油氣鑽探/生產工業對於環境友善議題正由損耗的、負面的觀點轉向成有利基的、正面的觀點。對於台灣最大的石油公司，營運超過六十餘年，即將面臨的末端生產所衍生環境問題會是更加嚴峻的，環境法規、群眾要求只會越來越嚴苛，環保問題或許"成事不足"，但絕對"敗事有餘"；正面、積極、遠瞻的面對、處理環境問題，提升環境友善技術，會是未來企業降低生產成本，增加獲利的重要途徑之一。

4.雖然近二年來國際原油價格高漲，使得全世界多數油公司獲利豐碩，然以台灣石油幾乎百分之百仰賴進口而言，卻是一項危機警訊。全球有限的石油存量、高漲的油價、國際溫室效應氣體排放抑制公約，迫使世界各國競相發展替代能源，雖然截至目前，不管是風力能、太陽能、水力能或生質能等，都尚未達到足以取代石油的階段，但「石油枯竭」卻是未來必然面臨到的問題，是未來的世界趨勢；雖然中油為台灣最大的石油能源公司，但依賴石油進口所能獲得的利基必將逐漸降低，對能源公司的長久經營而言，積極發展石油替代能源，是不容推卻的責任，也是企業永續發展的方向之一。許多夕陽工業衰敗的景象，令人怵目驚心的上演，繁華瞬間凋零，在今天這個十倍速運轉的時代，沒有不可能；不斷因應時代轉變，多元尋求生存之道，經營多角化，才是企業永續經營應變之門；今日石

油、碳氫能源的光彩，明日是否依然？在全球普遍體認環境問題的嚴重性之下，潔淨生產風潮正炙，我們是否仍持續冷眼旁觀替代能源的開發，輕忽環境友善技術的研究？！值得我們深切省思。

伍、附錄

「International Symposium on Oilfield Chemistry」研討會收錄論文一覽表

收錄編號	發表文章名稱/作者
SPE 96741	Limiting Scale Risk at Production Wells By Management of PWRI Wells *Eric J. Mackay, Heriot-Watt U*
SPE 100599	Use of Silicate-Based Drilling Fluids To Mitigate Metal Corrosion *M. McDonald, National Silicates, and K. Barr, S.R. Dubberley, and G. Wadsworth, Alliance Drilling Fluids*
SPE 102627	Salt Free: A Case History of a Chemical Application To Inhibit Salt Formation in a North African Field *Steve Szymczak and Randy Perkins, BJ Chemical Services; Mark McBryde, Anadarko; and Mohamed El-Sedawy, BJ Services*
SPE 102677	Fracture Stimulation Utilizing a Viscoelastic-Surfactant-Based System in the Morrow Sands in Southeast New Mexico *Vibhas J. Pandey and Tarik Itibrout, Schlumberger; Larry S. Adams, Chevron; and Tracy L. Cowan and Oscar A. Bustos, Schlumberger*
SPE 102711	Advanced Technology To Reduce Water Cut: Case Studies From the Pemex Southern Region *Gustavo A. Farrera Romo and Héctor Hernández Leyva, Cinco Presidentes Asset Team, Pemex, and Raúl Bonifacio Aguilar, Carlos Caballero Campos, Larry Eoff, and Dwyann Dalrymple, Halliburton*
SPE 102738	Inhibition and Removal of Low-pH-Fluid-Induced Asphaltic Sludge Fouling of Formations in Oil and Gas Wells *Kenneth M. Barker and Michael E. Newberry, Baker Petrolite*
SPE 104750	An Experimental Investigation of Interactions Between Supercritical CO_2, Aspheltenic Crude Oil, and Reservoir Brine in Carbonate Cores *Abdulrazag Y. Zekri, Shedid A. Shedid, and Reyadh A. Almehaideb, United Arab Emirates U.*
SPE 105048	A Case Study in the Removal of Deposited Wax From a Major Subsea Flowline System in the Gannet Field *H.A. Craddock, K. Mutch, and K. Sowerby, Roemex Ltd., and S. McGregor, J. Cook, and C. Strachan, Shell U.K. Ltd.*
SPE 105049	The Application of Wax Dissolver in the Enhancement of Export Line Cleaning *H.A. Craddock, E. Campbell, and K. Sowerby, Roemex Ltd.; M. Johnson, CNR Intl. Ltd.; and S. McGregor and G. McGee, Shell U.K. Ltd.*
SPE 105129	Well Modeling Incorporating Nonisothermal Effects and Asphaltene Precipitation *W. Thanyamanta, T.E. Johansen, and K. Hawboldt, Memorial U. of Newfoundland*
SPE 105485	Water-Based Drilling Fluid for HP/HT Applications *M.A. Tehrani and A. Popplestone, M-I Swaco, and A. Guarneri and S. Carminati, Eni E&P*

SPE 105505	Squeeze Chemical for HT Applications—Have We Discarded Promising Products by Performing Unrepresentative Thermal Aging Tests? *Rex Wat, Lars-Even Hauge, Kåre Solbakken, Kjell Erik Wennberg, Linda Merete Sivertsen, and Berit Gjersvold, Statoil ASA*
SPE 105765	Thermochemical Process To Remove Sludge From Storage Tanks *Nelson O. Rocha, Carlos N. Khalil, Lúcia C.F. Leite, and Andre M. Goja, Petrobras*
SPE 105784	One Year Experience With The Injection of Nitrate To Control Souring in Bonga Deepwater Development Offshore Nigeria *Cor Kuijvenhoven, Shell Intl. E&P B.V., and Jean Christophe Noirot, Paul Hubbard, and Lukman Oduola, Shell Nigeria E&P Co.*
SPE 105815	Anionic Surfactant Gel Treatment Fluid *Thomas D. Welton, Jason Bryant, and Gary P. Funkhouser, Halliburton*
SPE 105858	Formation Damages Caused by Emulsions During Drilling With Emulsifi ed Drilling Fluids *Ingebret Fjelde, IRIS*
SPE 105907	Conformance and Mobility Control: Foams vs. Polymers *Guoyin Zhang and R.S. Seright, New Mexico Petroleum Recovery Research Center*
SPE 105925	A Study of Polyacrylamide-Based Gels Crosslinked With Polyethyleneimine *G.A. Al-Muntasheri, Delft U. of Technology and Saudi Aramco; H.A. Nasr-El-Din and K.R. Al-Noaimi, Saudi Aramco; and P.L.J. Zitha, Delft U. of Technology*
SPE 105935	Oxidation as a Rheology Modifi er and a Potential Cause of Explosions in Oil and Synthetic-Based Drilling Fluids *K. Shahbazi, S.A. Mehta, R.G. Moore, M.G. Ursenbach, and K.C.V. Fraassen, U. of Calgary*
SPE 106005	Application of Viscoelastic Surfactants as Mobility-Control Agents in Low-Tension Surfactant Floods *Istvan Lakatos, Janos Toth, Tibor Bodi, and Julianna Lakatos-Szabo, U. of Miskolc, and Paul D. Berger and Christie Lee, Oil Chem Technologies*
SPE 106006	Designing Cement Slurries for Preventing Formation Fluid Infl ux After Placement *Ashok Santra, B.R. Reddy, and Mfon Antia, Halliburton*
SPE 106010	Design of a Novel Composite Agent for Improving the Toughness of Oilwell Cement Sheath *X. Yao and S.D. Hua, Nanjng U. of Technology, China*
SPE 106012	Sensitivity Study on the Main Factors Affecting a Polymeric RPM Treatment in the Near-Wellbore Region of a Mature Oil-Producing Well *O. Vazquez, M. Singleton, and K.S. Sorbie, Heriot-Watt U., and R. Weare, Baker Petrolite*
SPE 106016	Nanoemulsions: A New Vehicle for Chemical Additive Delivery *Lucilla Del Gaudio, Eni E&P; Rossella Bortolo, Eni R&M; and Thomas P. Lockhart, Eni E&P*
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