

CHEMICALS IN THE OIL INDUSTRY

Recent Developments



Edited by Lesley Cookson
and Paul H. Ogden

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Preface

Increasing water break-through in maturing oil-wells and the need to develop less accessible oil deposits has lead to steadily growing consumption of well management and production chemicals. This, together with higher performance requirements of chemical formulations and increasing restriction of chemical choice due to environmental constraints, make this industry highly challenging. However, reward for success can be high and the combined chemical and service value of this market has been estimated to be \$6 billion world-wide by the author of the opening paper which describes the development of the industry over the past few years.

The cost of chemical treatment can represent a significant portion of total oil production cost and the industry is countering its escalation by reviewing attitudes towards the interface between oil producer and oilfield service company. Papers from both camps consider the growth of partnering and the advantages it can offer. Perusal of the list of delegate affiliation at this sixth of the Chemistry in the Oil Industry Symposia, which have spanned fifteen years, indicated one possible result of these changes with increased representation of chemical supply and service companies and decreased representation by oil producers.

The technical sessions address a range of subjects, which the organising committee considered to be topical and wished to give an indication of the broad range of chemical techniques which are being employed. Regrettably several equally interesting subjects could not be included in a short meeting of this type.

We are indebted to members of the organising committee:

Mike Fielder (BP), Ian Macefield (Allied Colloids), Terje Schmidt (Statoil), and Rob Vreeburg (Shell) for their help and advice,

and to Laporte plc for their generous sponsorship.

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Worldwide Oilfield Chemicals Market Review

C. Houston

OILCHEM RESEARCH, 12962 DAIRY ASHFORD, SUGAR LAND, TEXAS 77478, USA

Oilchem Research conducts market research projects on oilfield and refinery chemicals and services through single and multi-client projects; multi-client studies representing the backbone of our data-base which is used for the preparation of this type of paper. Such data is obtained through interviews with service companies, oil and gas operators, and chemical companies in order to determine worldwide chemical consumption patterns and the needs in the oilfield and refinery chemical segments (Figure 1).

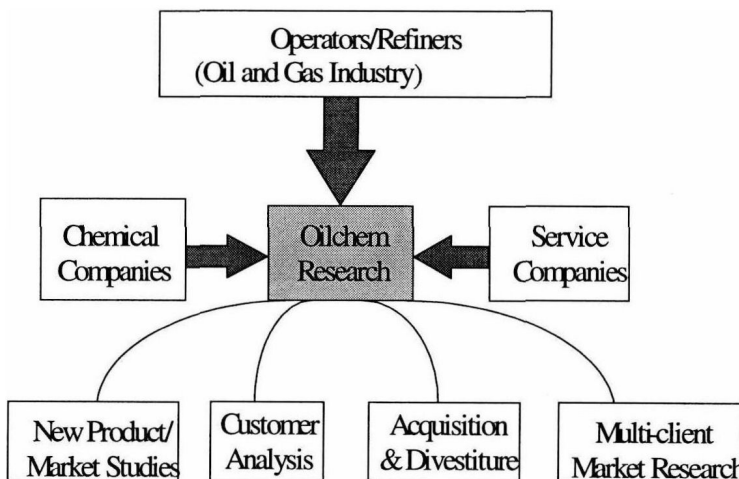


Figure 1 Overview – Data gathering processes

The major oilfield chemical segments are described in Figure 2. Drilling and completion fluids utilize a broad range of products from barite to synthetic polymers and these two segments have seen the most innovation during the 1990s due in part to the creation of synthetic drilling fluids which include classes of chemicals known as olefins, esters, acetals, alkylbenzenes and paraffins.

Drill-in fluids are becoming more popular as a more effective way of drilling through the pay-zone on horizontal wells. Utilization of clear brines based on calcium and zinc

bromide continue to gain favour in an effort to provide a cleaner well bore prior to completion.

- Drilling Fluids
- Completion and Workover Fluids
- Pumping Services
- Production Chemicals
- EOR
- Wholesale and Intermediates

Figure 2 *Major Oilfield Segments*

In 1996 oilfield chemicals and services represented a \$6.0 billion market. North America represented about 55% of the total amount of chemicals and services. There has been a surge in oilfield chemical usage over the past 2 - 3 years in the USA as the wave of new Gulf of Mexico exploration has yielded significant new reserves for both oil and gas (Figure 3). The international market continues to grow at about 3 - 5 % annually though some countries such as Venezuela have been growing at 10% per year for several years.

Division of chemical requirement by segment is described in Figure 4. Pumping services is the leading oilfield chemical and services function of all the segments - it is also the most equipment intensive and this aspect accounts for a large portion of the sales revenues.

- ◆ The world wide oilfield chemical and services market is worth \$6.0 billion in 1996.
- ◆ The International market represents about 45% of the total.

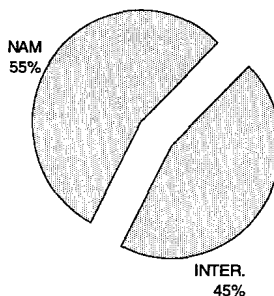


Figure 3 *World-wide Oilfield Chemical Outlook - Summary*

Drilling fluid sales have rebounded nicely over the past several years due in part to a new category of fluids - synthetics - and the increase in overall activity (especially North America). Canada announced just last month that it expected to drill approximately 15,000 wells in 1997 - a record for the country.

Pumping services is still highly orientated to North America where the largest number of wells are cemented and/or stimulated on an annual basis. The North American pumping

services market is very sensitive to current and forecasted oil and gas prices and hence activity can vacillate widely year to year.

The production chemicals market has seen only modest growth though there has been a significant amount of supplier consolidation so far in the 1990s.

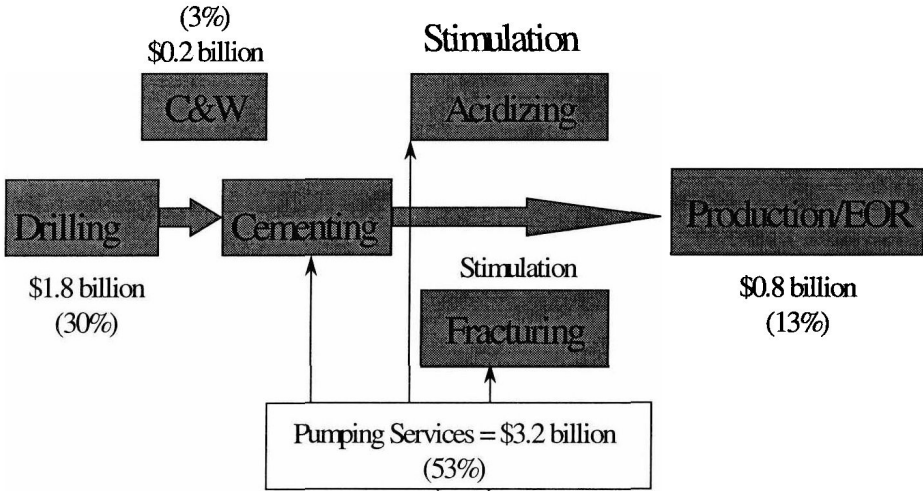


Figure 4 Oilfield Chemical Segment Stages - 1996

It is always interesting to show the relative level of market size by region for the major oilfield chemical segments. North America is the largest oilfield chemical user due in part to its preference for doing fracturing and to a lesser extent acidizing. These two oilfield chemical segments comprise over \$1.0 billion in sales alone for North America. As mentioned previously, usage of drilling and completion fluids has also rebounded substantially in the USA and Canada over the past 3 years. The USA and Canada have close to 1 million oil and gas wells with the USA representing roughly 90% of the total (Figure 5).

The consolidation of oilfield chemical and service companies during the past 7 years has been extensive. It is interesting to note that for most regions and/or countries, only 3 - 4 service companies exist for the bulk of the market. During the 1980s, as many as 7 - 8 major companies existed in each given segment. Several of these mergers are described in Figures 6 and 7.

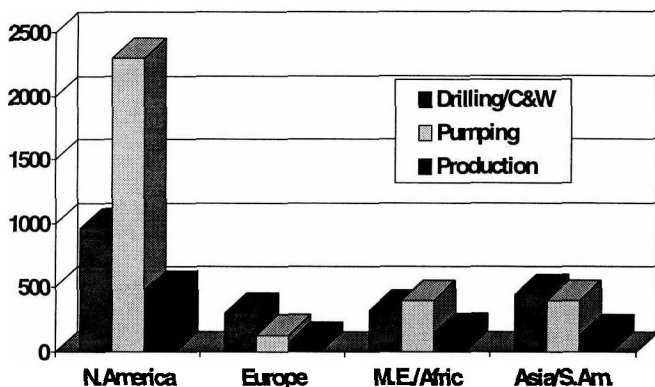


Figure 5 *Regional Oilfield Chemical Sales by Segment - 1996 (million dollars)*

- Drilling - Four companies represent approximately 90 - 95% of the worldwide market for drilling fluids (M-I, Baroid, Inteq, Dowell Schlumberger)
- Pumping - Three companies have a combined market share of about 90% of the worldwide market for pumping services (Halliburton, Dowell Schlumberger, BJ)
- Production - Four companies comprise about 75% of the market (Baker/Petrolite, Nalco/Exxon, Champion, TROS)
- Wholesale Specialty - Many companies to list but some majors include Witco, Nalco/Exxon, ICI, Hoechst, Baker, Dow, Champion, Aqualon, Rhone Poulenc, SKW, Union Carbide, Cytec, SNF, Kelco, Allied Colloids and many others

Figure 6 *OFC Overview*

Here is a brief list of some of the companies present in the market which have been bought or merged since 1990. We estimate that this consolidation has been worth about \$1.2 billion in sales (without Petrolite) or about 20% of the overall market value in 1997.

The largest (over \$100 million) oilfield chemicals and services companies are the pumping services companies - namely, Halliburton, Dowell Schlumberger, and BJ Services. Drilling fluids companies comprise the next largest group with Baroid, M-I (includes Anchor Drilling Fluids acquisition), and Baker/Inteq (which also includes Baker Performance Chemicals). Finally, production chemical companies make up the balance of the companies (Figure 8).

- Drilling Fluids: IDF, Fremont, Anchor, Chemrich
- Pumping Services: Western, Newsco, Serfco, Acid Engineering
- Production Chemicals: Quaker/Alpine, Chemlink, Welchem, Nalco/Exxon, Betz Energy Chemicals, Hays Oilfield Services, Petrolite
- Wholesale - BASF, Chemlink, others

Figure 7 *Oilfield Chemical Company Consolidation Since 1990*

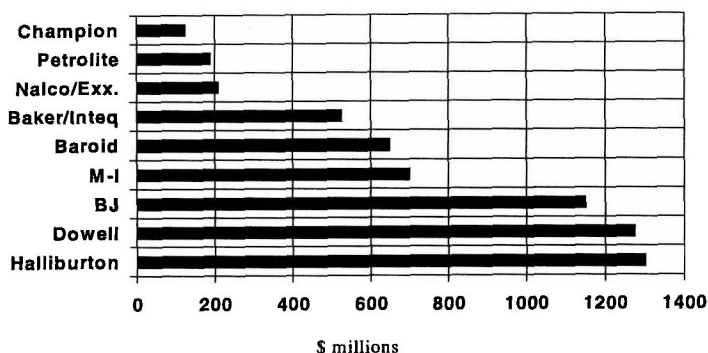


Figure 8 *Worldwide Oilfield Chemicals and Services Sales, 1996 (\$ millions)
(includes wholesale sales)*

During interviews the question of definition of specialty is often raised. Figure 9 describes a general (but not all inclusive) list of the products Oilchem Research personnel consider specialty chemicals:

- Polymers is a vast group of products which represents the largest oilfield chemical segment if one includes HEC, Xanthan Gum, CMC, and PHPA polymers.
- The second largest line of specialties are demulsifiers - particularly if surfactants and emulsifiers are included in the total.
- Corrosion inhibitors also represent a significant portion of the total.

To briefly review the state of individual oilfield chemical segments; as mentioned previously, the drilling fluid market has been on a steady increase since 1992. Utilization of synthetic fluids, which have cost upwards of \$400 per barrel at times, coupled with a general rebound in drilling have been the primary factors for the increase (Figures 10 and 11).

- Drilling: Corrosion Inhibitors, Biocides, Dispersants, Fluid Loss Additives, Select Polymers, Emulsifiers, Lubricants, Others
- Pumping: Corrosion Inhibitors, Biocides, Scale Inhibitors, Surfactants/Dispersants, Select Polymers, Others
- Production: Demulsifiers, Biocides, Scale Inhibitors, Corrosion Inhibitors, PPDs, Pipeline Drag Reducers, Others

Figure 9 Oilfield Specialty Chemicals - Types

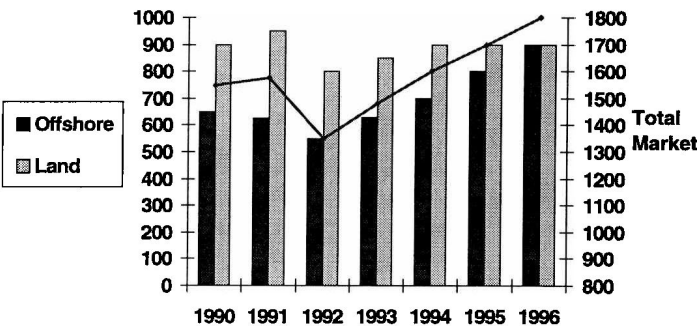


Figure 10 Worldwide Drilling Fluids Market 1990-1996 (\$ millions)

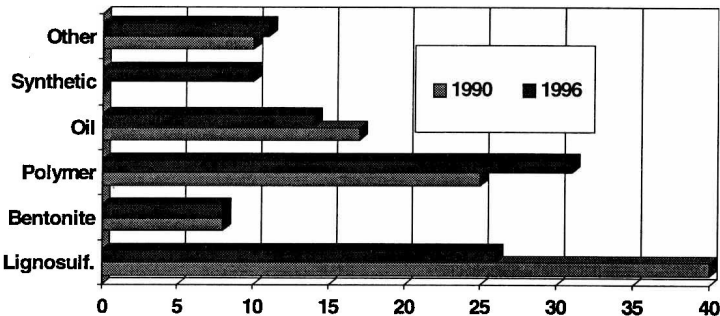


Figure 11 N. America Drilling Fluid System Development, 1990 versus 1996 (% of Total \$ Market)

As can be seen from the figure above, the types of drilling fluids used in the industry has changed significantly since 1990 when lignosulfonate muds were still the preferred system for most applications. Polymer muds of all types continue to grow in popularity while the introduction of synthetics has had the largest impact in North America. A similar trend is occurring in the international market though new muds based on polyols and silicates are being given serious consideration as possible replacements for synthetics.

The completion and workover (C&W) fluids market continues to grow as wider acceptance of clear brines occurs. Both the USA and North Sea consume the largest quantities of C&W fluids with calcium bromide being the fluid of choice for both markets (Figure 12). These two regions are fully aware of the benefits of clear brine fluids but other regions of the world use the products more sporadically.

- \$240 million worldwide market in 1996
- Three key suppliers - Baroid, Tetra, OSCA - and several strong regional suppliers in the USA and the North Sea
- The USA and North Sea represent about 80% of the world market
- Trend to utilize clear brine fluids increasing

Figure 12 *Completion Fluids - Summary*

There are a number of questions which may affect the utilization of clear fluids in the completion and workover market (Figure 13). Drill-in fluids are growing rapidly as the horizontal well drilling continue to be successful. Some operators are looking at alternatives to bromides such as formates in select applications. As mentioned previously, usage of clear fluids outside of the USA Gulf of Mexico and North Sea is erratic - few consistent markets have developed

- ◆ What will be the impact of “drill-in” fluids?
- ◆ Is there a substantial need for more environmentally friendly fluids?
- ◆ When will technology grow beyond the North Sea and the Gulf of Mexico?

Figure 13 *C&W Questions*

The pumping services oilfield chemical market comprises cementing, acidizing and fracturing operations. The major suppliers of these products and services include Halliburton, Dowell Schlumberger (DS), and BJ Services. Halliburton and DS have

traditionally been the largest suppliers of pumping services but BJ has purchased two major companies (Western and Nowsco) during the past several years (Figure 14).

Pumping service companies purchase the majority of their chemicals, similar to the drilling fluid chemical companies, from both the commodity and specialty chemical companies.

- Cementing, acidizing, and fracturing products and services
- Stimulation activity is very reactive to oil and gas price movements
- Most service companies purchase chemical products rather than manufacture them
- BJ Services has purchased several large competitors to consolidate the market

Figure 14 *Pumping Services*

Pumping services companies utilize a wide range of products. The companies purchase the products at central locations in the USA and Europe for both worldwide distribution. They also buy oilfield chemicals and products locally if it is cost-effective. The segment is very equipment intensive and hence this part of the overall job cost can represent upwards of 50% of the total ticket (Figure 15).

- Chemicals (hydrochloric acid, gellants)
- Products (sand, cement, ceramic proppants)
- Equipment (trucks, boats...)
- Engineering services
- 50% of the job ticket is chemicals and products, balance service and equipment

Figure 15 *Pumping Services*

A general definition of the production chemical market is provided . These chemicals are typically manufactured by the oilfield chemical suppliers which include Petrolite (which is scheduled to be purchased by Baker Hughes), Nalco/Exxon Energy Chemicals, Baker Performance Chemicals, Champion Technologies, TROS and many others. This oilfield chemical segment is the only segment where the suppliers are for the most part intimately involved with the oilfield chemical manufacturing process (Figure 16).

- Oil and gas is typically produced with water with the components requiring treatment to separate the oil and gas from water
- Production chemicals also protect equipment from corrosion, scale, bacterial growth, wax deposition, and the formation of hydrogen sulfide

Figure 16 *Production Chemicals*

The most important driver of production chemical usage is the amount of water produced in association with the oil. In the USA, the water/oil ratio can reach over 50:1 compared with fields in the Middle East which have been known to be shut-in when they begin to produce water. Referring back to the previous chart, the USA has treating costs approaching 15 cents/barrel, while in the Middle East is still under 1 cent. The following chart shows the effect of increasing water to oil ratios and treating costs over time in the USA (Figure 17).

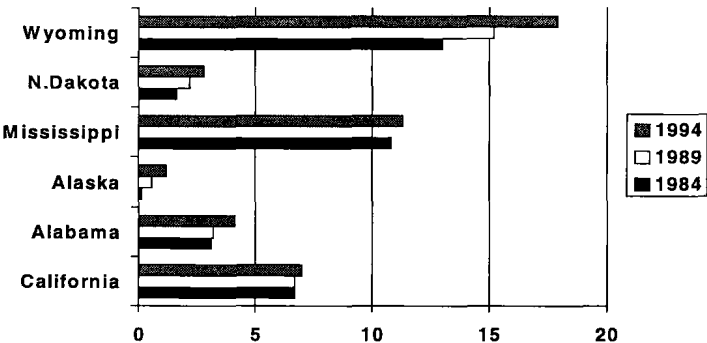


Figure 17 *Water/Oil Ratios – USA (barrels of water produced/barrels of oil produced)*

The higher treating costs in the USA coupled with the relatively low oil and gas prices of the past decade have resulted in an oil production decline from 9 million barrels/day in 1985 to about 6.5 million barrels/day in 1996. The number of producing oil wells in the USA continues to decline from 640,000 in 1985 to approximately 580,000 in 1996 as does oil production (Figure 18).

The following chart summarizes the sales of the major production chemical companies. There is still a large number of companies participating in the market despite the extensive consolidation which has taken place over the past 6 years. The combination of Petrolite and Baker would give the company a sizable share of the market (Figure 19). Other companies are likely to be considering acquisitions and/or mergers. (Note: Sales estimates are for production chemical service sales only - wholesale sales are not included.)