Starting Out in the Oil Industry

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Oil Recovery

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Basics of Oil Recovery

- Oil exists in the pore spaces of reservoir rock, not in big pools!
- Deposits are located by various surveying techniques.
- Initially this oil is under pressure – drilling into producing zones means oil will naturally rise to the surface (primary recovery, able to extract 5 – 15% oil).
- Once this pressure has depleted, we need to inject either water or gas to drive production (secondary recovery, gives us 35 – 45% recovery).
- Finally we can use different techniques to affect the mobility of oil which cannot be accessed *via* primary or secondary means. Injection of steam or surfactants is called enhanced oil recovery, results in production of 50 – 70% of hydrocarbons in a reservoir.
- Each of these stages costs money, application depends on the price of oil.
- With time, the amount of oil obtained at the surface drops. Many North Sea fields are currently at > 90% water cut!

Problems (and Opportunities)

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Problems During Oil Recovery

– Numerous issues can arise when producing a reservoir.

– These depend on e.g.

- Type of formation rock
- Pressure
- Temperature
- pH
- Formation water properties
- Oil properties
- Gas composition
- Materials used to build rigs and pipelines
- The presence of bacteria

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Scale

– Scales are insoluble deposits formed during oil production.

– They block reservoir pores, pieces of equipment or entire pipelines!

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- Scales are insoluble deposits formed during oil production.
- They block reservoir pores, pieces of equipment or entire pipelines!
- Scales can form when:
  - Injection waters (sulfate rich) meet formation waters (barium/strontium) rich – $BaSO_{4(s)}$ or $SrSO_{4(s)}$
  - Waters undergo a drop in pressure, releasing $CO_{2(g)}$, raising the pH and encouraging precipitation of $CaCO_{3(s)}$
  - High temperature, high pressure reservoirs release cations (iron/zinc/lead) which combine with sulfide – $FeS_{(s)}$, $ZnS_{(s)}$ or $PbS_{(s)}$
  - Highly saline brines cool on reaching the surface, depositing $NaCl_{(s)}$
- One BP field went from producing 30,000 barrels ($2 million) PER DAY to zero in 24 h due to scaling

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Corrosion

- Corrosion of steels in the presence of water is a huge problem in the industry.
- Engineering and materials selection play an important role in the lifetime and safety of offshore installations.
- Corrosion of pipelines and equipment can be caused by oxygen, carbon dioxide or hydrogen sulfide.
- The actual process of corrosion can take several forms (general/local) with different results.

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- The actual process of corrosion can take several forms (general/local) with different results.
- Corrosion in one surface pipeline in Alaska (2006) cost BP upwards of $25 million. They spent $500 million installing new anti-corrosion systems to prevent it happening again.

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Flow Assurance

– Oil, gas and water in reservoirs are at equilibrium; producing the fluids disturbs this and can lead to phase changes.

– Gas can evolve from oil, gas hydrates may form, solids (waxes, resins, asphaltenes) can deposit within the oil phase, flow characteristics may change.

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Flow Assurance

- Oil, gas and water in reservoirs are at equilibrium; producing the fluids disturbs this and can lead to phase changes.
- Gas can evolve from oil, gas hydrates may form, solids (waxes, resins, asphaltenes) can deposit within the oil phase, flow characteristics may change.
- All of these disrupt the movement of fluids to surface facilities.
- Ensuring flow is becoming more of a challenge as deeper reservoirs, with heavier oils, are produced.
- This is a growing discipline, almost unheard of in the 1990s, has since caused months of lost production and even field abandonment

Roles of Chemists

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What can chemists do?

- Oilfield operators employ **chemical service companies** to manage these risks.
- It is our job to predict problems, design mitigation strategies, formulate, test and recommend chemicals that will allow problem free production.
- Successful companies will develop products that are:
  - Efficient (but not overly so)
  - Cost effective
  - Stable in the various environments to which they will be exposed
  - Environmentally acceptable
  - Detectable with confidence at the surface
  - Proven in other fields!

Chemistry Job Types

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Chemistry Jobs in the Oil Industry

- The most common role is within a **service company** (Clariant, Nalco/Champion, MI-SWACO, Baker Hughes), conducting testing and development of products.
- The chemistry here is quite basic (using already available molecules) but very fast-paced, requiring the ability to adapt to new situations, recognise what customers desire, juggle multiple projects at once and keep within strict time-frames.
- The emphasis can be on finding the best product or the cheapest product, the aim is always to sell what the customer wants to buy!
- This job offers the opportunity to travel and gain experience in a number of disciplines.
- People often join service companies with a BSc or Masters degree – PhD is definitely not required.
- Service companies are located in various locations, many in Aberdeen.

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Chemistry Jobs in the Oil Industry

- Most service companies have **divisions dedicated to innovative chemistries**.
- Workers in these roles will not interface with customers and will be less time-constrained.
- Their aim is to produce new chemistries to tackle existing problems or to pre-empt future problems (changing legislation, new product requirements).
- A broad knowledge of chemistry is necessary, being able to search a company's patent portfolio to find compounds that may fulfil multiple roles.
- These jobs tend to require a PhD.
- Research chemists are less visible within a company and their roles are dependent on the requirement for new chemicals.
- Innovation centres are located overseas (Germany, USA).

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Chemistry Jobs in the Oil Industry

- Service companies also send chemists **offshore** on a rotational basis.
- The work is very basic (sampling, labelling, sending back onshore) but physically demanding.
- Working to rule is critical offshore, everything must be documented and numerous safety procedures followed.
- Many operators look for experience in offshore staff, it would be very difficult to get an offshore chemist job without at least some previous experience in a service company.
- Some people suit offshore work (hours, salary), others don't (missing family occasions, repetitive tasks).
- Positions may be lost if offshore rotas change.

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Chemistry Jobs in the Oil Industry

- Some **universities** have petroleum research departments.
- In the UK we have Leeds and Cranfield (corrosion) plus Heriot-Watt (scale and flow assurance), overseas there is Rice University (Texas).
- These institutions receive direction from service companies, performing tasks that are either too time-consuming, expensive or niche for any one company to focus on.
- Projects are tackled by Masters or PhD students with results fed back around twice per year.
- This job is ideal for students who prefer academia, there is some time pressure but the harder you work, the more recognition you will get.
- You gain exposure to all service companies!
- Chemists are exposed to pressing issues of the moment.

My Experience

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My Career Path

- I completed my PhD research in 2011.
- I worked for Heriot-Watt University with Clariant Oil Services for three years.
- My role was to develop a new class of scale inhibitor for deployment in the Norwegian Sector of the North Sea.
- I was able to conduct my academic research at a faster pace, keeping in contact with the customer and seeing what “business as usual” meant at Clariant.
- I travelled to Norway, Germany and the USA, presenting at conferences and attending various training courses.
- At the end of the three years I decided to stay within the service company:
  - I wanted to see the results of my work quicker
  - I enjoyed the time demands
  - There was more collaboration than I found in academia

Advantages and Disadvantages to Working in the Oil Industry

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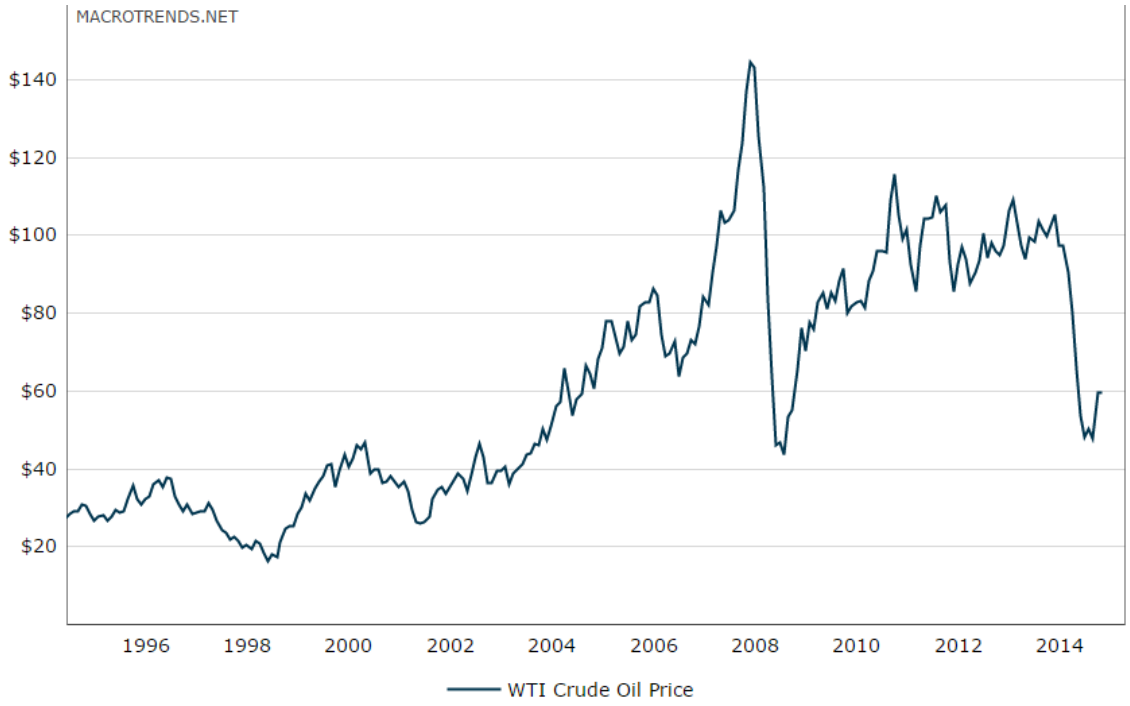
Disadvantages

– All jobs in the oil industry are dependent on the price of oil.

– If our customers' profits decrease, it has an immediate knock-on effect on us.



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Disadvantages

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- If our customers' profits decrease, it has an immediate knock-on effect on us.
- This boom and bust can make it a stressful job!
- In times of low oil price, certain roles are more liable to be cut (i.e. innovation, those focussing on development of new fields) and career progression may stagnate.

- It can be difficult to develop new technologies as operators are reluctant to be the first to try anything new.
- Innovation can be stifled by customers' focus on keeping costs low, not seeing how novel chemistries may benefit them in the long run.

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Advantages

- North Sea oil is declining but oil production is continuing around the world – oilfield chemistry is a global career!
- You can solve tangible problems with immediate effect. Building up a list of fields you have had a direct impact on rather than a list of publications.
- There is the opportunity to do real research in a number of disciplines.
- Chemists can become conversant with people from other roles (salespeople, geologists, engineers, ESHA).
- Travel is part of the job.
- There is the opportunity to go offshore.
- Salaries are competitive.

Any Questions?

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