Introduction

“Fingerprinting” oil is a process that refers to analytical chemistry techniques by which crude oil is defined into its components in such a way as to permit the identification of a particular sample of crude oil by the uniqueness of its composition.

Originally, star diagrams graphically depicting the relative quantities of specific aromatic compounds were used as oil fingerprints. Within one compartment of an oil field, star diagrams were usually identical since the oil composition is completely homogenized.

![Star fingerprint of oil in Eider, Eider-SW and Otter fields.](image)

Figure 1-Star fingerprints of oil in Eider, Eider-SW and Otter fields. (source: Ganz, H.H., Hempton, M., Knowles, W., Van der Veen, F., and Kreulen, R., Integrated Reservoir Geochemistry: Finding Oil by Reconstructing Migration Pathways and Paleo Oil-Water-Contacts, Society of Petroleum Engineers, Paper SPE 56896.)

Purpose

The process of “fingerprinting” oil was developed to assist oil companies identify the source reservoirs from which oil is taken. When a new well intersects oil, for example, it is useful to know whether this is a new source of oil or the extension of a previously discovered source. In this manner the extent of a reservoir can be mapped and the size of the estimated.

The process came into further use in the economic exploitation of reservoirs by facilitating the commingling of oil from more than one reservoir through a common well. In such instances, reservoirs lie on top of each other and hence one well can pass through multiple reservoirs. Prior to the development of oil fingerprinting technology commingling of oil through a common well was not...
feasible, thus entailing a new well for each reservoir. Fingerprinting technology allows the oil from multiple wells to be commingled and the respective contributions identified by source and proportion.

The economic savings available through wells designed for commingling could be as much as US$1 million US$ per well less expensive than conventional wells. Fingerprinting Technology also provides information on the history of a particular crude oil accumulation and its original source. This information can be used to inform exploration came from and this information can increase the chances of exploration success.

In defining the size of a reservoir Fingerprinting Technology can help determine if the reservoir penetrated by a particular well is the same reservoir as has been penetrated by other well. Accumulated knowledge from the application of Fingerprinting Technology in region will assist in determining the size of the extent and volume of the field. Such information is also useful in planning the development of the field and specifically the number and location of wells required to drain the field.

In respect to oil theft, at its most basic level fingerprinting can be used to quickly distinguish between natural crude oil, kerosene and artificial products. A more detailed analysis can determine the source reservoir and therein test the bona fides of the person in possession.

Analysis
No common analysis basis or criteria for fingerprinting oil has yet been established among analysts. Therefore, analysis by different companies may (and probably will) produce a different fingerprint (or profile). However, such analyses will be internally consistent. SPDC currently uses 10 components as the basis for its analyses. Other companies may not only use a different number of criteria but may also use different criteria.

Experience
Chevron has the longest experience in fingerprinting oil. It has a laboratory in Lagos that conducts analysis. Shell routinely conducts analysis in Nigeria and the Netherlands. It is understood (but yet to be confirmed) that all major oil companies have developed fingerprinting technology.

Extent of Application
The extent of application and accuracy of fingerprinting technology is related to the size of the database used for comparison with the target sample. Individual companies are each building their own databases.

SPDC currently has an 800 samples database from reservoirs plus samples from 40 trunk lines in Nigeria. This is likely the most extensive database yet developed by any company.

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1 Shell Bulletin Number 4
2 SPDC – Shell Petroleum Development Company of Nigeria Limited
Companies could exchange oil samples to build up a national database. They would then test the samples to develop fingerprints based on their own proprietary analytical techniques. This would protect the analytical technology of each company.

A national “library” of reference samples could also be established. This would be cumbersome and have limited usage, as the national reference samples would have to be analysed using the technical process of the enquiring body analysing the target sample.

The most practical step would be for general agreement on the analytical process used to identify the oil source and the widespread adoption of that process. Of course there is the issue of proprietary rights and the competitive advantage of each company that has developed their own analytical processes thus far.

With the widespread use of an agreed analytical process, an international database of oil fingerprints could be developed. This would provide a quick and readily accessible register of known oil sources against which samples of suspect crude oil could be compared.

**Limitations**
Currently there is no commonality in the type and number of components used by various oil companies to identify crude oil.

Oil Spills: Oil that is spilt degrades and source identification is not accurate unless a sample is taken early in the spill.

Blending: There is a question as to whether the blending or mixing of crude oil that occurs in tankers when transporting crude oil will disguise the source of the individual crude oils. This is not dissimilar to the commingling that occurs when oil is transported through trunk lines or more than one well is tapped by a well (to be confirmed).

**Conclusion**
Fingerprinting technology has been developed by most of the large oil companies and is routinely being used to identify the source of crude oil to assist in tracing sources of oil spills, defining reservoir extents and volumes, commingling to facilitate extraction and transport of crude oil. It is also currently being used at the request of police in Nigeria to identify the cargoes of suspected oil thieves. The use of oil fingerprinting technology can be extended (and standardised) as an essential tool in identifying the source of suspected stolen oil.

**References**
International Meeting on Organic Geochemistry, Maastricht/The Netherlands (1997), 1, 109.


For more information on oil theft, see the Legaloil.com website at http://www.legaloil.com.