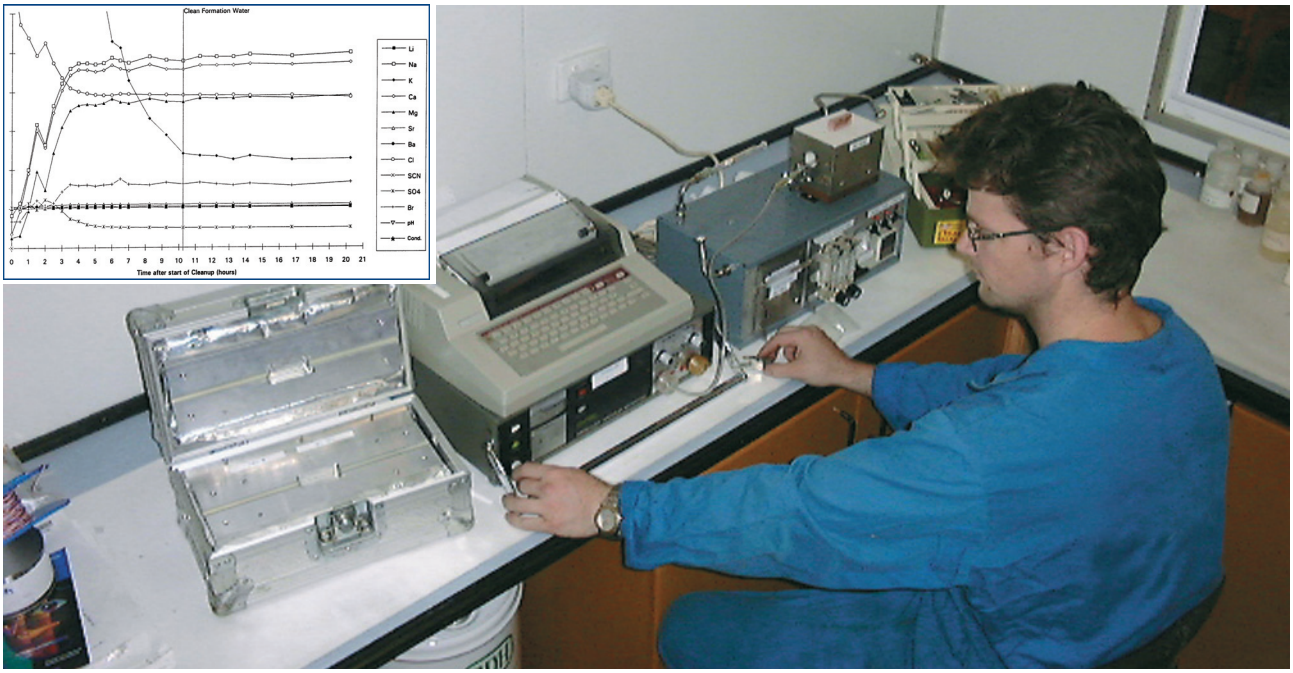
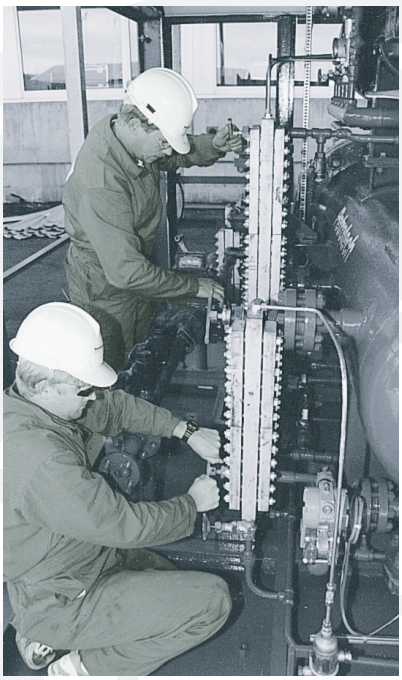
Non-hydrocarbons and trace elements

Natural gas, condensate and oil produced from an underground reservoir will always contain certain non-hydrocarbon components and trace elements. These constituents may be considered as impurities or contamination of the hydrocarbons and must be accurately quantified prior to field development.



Some constituents are non-combustible and of no economic value, while others are corrosive, calling for special design and materials in processing and transportation systems. Others may be environmentally unfriendly, poisonous, or simply dilute the hydrocarbon fraction thereby reducing the calorific value. Their presence even in trace amounts should not be ignored.



The most important non-hydrocarbon constituents in petroleum fluids are:

- Sulphur compounds (hydrogen sulphide, mercaptans, carbonyl sulphide etc.)
- Non-combustible gases (nitrogen, carbon dioxide, helium, argon etc.)
- Radioactive components
- Mercury
- Other heavy metals
- Formation water

The quality of the oil and gas, measured in terms of impurities, strongly influences the market price.

Analysing for non-hydrocarbons requires understanding and special precautions. Many components have a tendency to adsorb onto surfaces (eg sampling lines and sample containers). This can lead to a severe reduction in their measured concentrations. Other components, such as radioactive elements may be affected by delays in the analysis. Therefore, analysis must be performed onsite on line systems or on samples especially cooected or preserved for later analysis. As the concentration of non-hydrocarbons varies so much in different reservoirs, sampling must in many cases be optimized on site.

Non-hydrocarbons and trace elements

NATURAL GAS ANALYSIS

Expro has extensive experience with onsite gas sampling and analysis and can perform the following analyses:

Hydrogen sulphide (H_2S)

Hydrogen sulphide is a highly toxic and corrosive gas, present in concentrations from sub ppmv-level to several percent in natural gases.

According to application, Petrotech can offer several field methods:

a) Dräger tubes under line pressure. Various tubes are available for an analytical range of 0.1-2000 ppmv. A simple, and robust method.

b) Iodometric/potentiometric titration, (ASTM D2385 or UOP 212). Recommended for low ppm.

c) Jerome H2S-analyzer. Gold-film principle with Hand-held instrument which provides a quick approximate determination of H2S in ppm-level.

d) Microcoulometric method.

Mercaptans (R-SH)

Mercaptans are a group of malodorous and toxic sulphur compounds which are rarely found in hydrocarbon gas. Analysis is performed with Dräger tubes, potentiometric titration (ASTM D2385 or UOP 212) and micro-coloumetric method.

Carbonyl Sulphide (COS)

Potentiometric titration (UOP 212).

Carbon dioxide (CO_2)

Carbon dioxide is a corrosive but stable gas. The content in natural gases can vary from a few ppm to over 90%. Analysis is performed with Dräger tubes or gas chromatography.

Radon-222 (Rn)

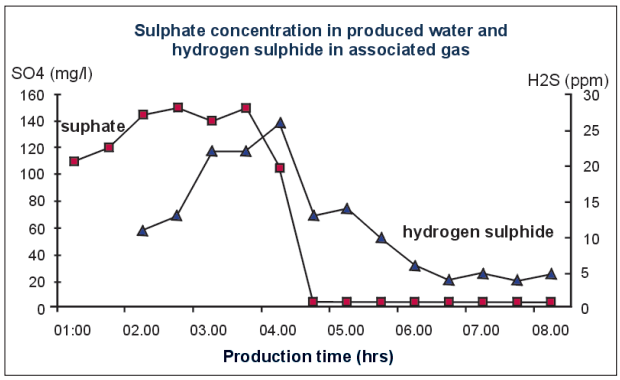
Radon-222 is a radioactive isotope. It originates from radium-226 and has a half-life of 3.8 days. Analysis is performed with a dedicated Radon detector.

Mercury (Hg)

Mercury is a toxic and corrosive element which varies in concentration from ng/m3 to mg/m3 in gas from hydrocarbon reservoirs. Elemental mercury is analysed onsite by an amalgamation technique on a noble metal followed by stripping to a cold vapour atomic absorption spectrophotometer.

Argon (Ar) and Helium (He)

Argon and helium are non-combustible noble gases which reduce the calorific value of the gas. At concentrations above 0.2 % it may be economically attractive to extract the noble gas for sale. They are analyzed in the laboratory using gas chromatography with a thermal conductivity detector (TCD).



Correlation between Hydrogen Sulphide in the gas and Sulphate content in water

ON-SITE MEASUREMENTS OF TRACE ELEMENTS IN GAS

Client	TRP Oil Company
Well	A-12
Flow Period	Main Flow
Sample Point	Test Separator

Date	Time	H2S (ppmv)	CO2 (mol %)	R-SH (ppmv)	^{222}Rn (Bq/m^3)	Mercury (μ/m^4)
09.08.95	10:00	5.0	2.0			
"	10:30	8.0	5.0		201	
	11:45					0.08
"	11:00	12.0	4.5	< 0.5		
"	11:30	17.0	5.0			0.07
"	12:00	18.0	5.0			
"	12:30	18.0			192	
"	13:00	18.0	4.5	< 0.5		
"	13:30	18.0	5.0		187	
"	14:00	18.0	5.0			0.07
"	15:00	19.0	5.0			
"	16:00	18.0	5.5			0.06
"	17:00	18.0	6.0	< 0.5		
"	18:00	18.0	5.0		223	
"	19:00	19.0	5.0	< 0.5		
"	20:00	18.0	5.0			
"	21:00	18.0	5.0			

Nitrogen (N2)

Nitrogen is an inert gas which reduces the calorific value of the hydrocarbon gas. Samples are analyzed in the laboratory using gas chromatography with a thermal conductivity detector (TCD).

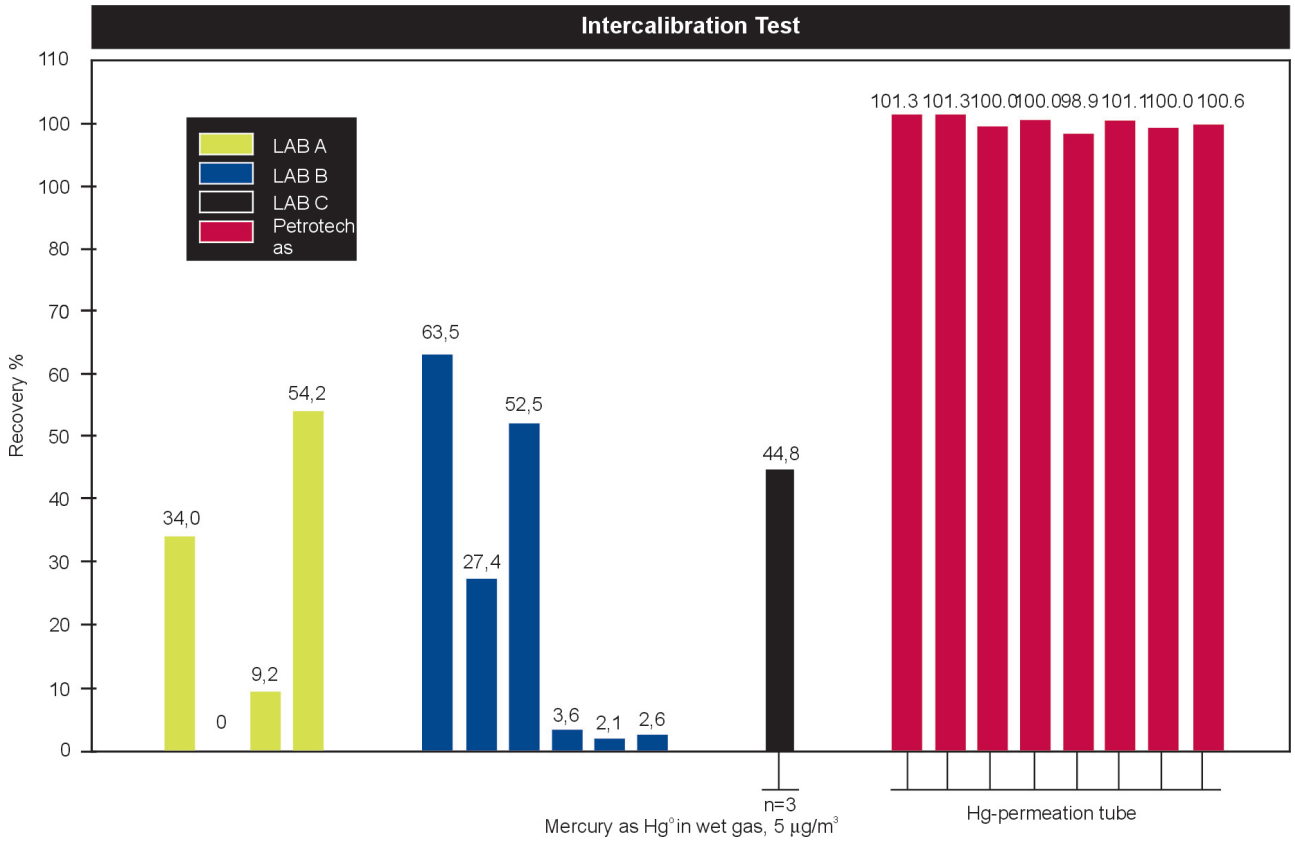
Arsenic (As)

Arsenic is absorbed onto activated charcoal which is subsequently analysed onshore by atomic absorption spectrophotometry. (AAS).

Addition Analysis

Other analysis of trace components in gas are performed on request.

Non-hydrocarbons and trace elements



OIL/GAS CONDENSATE ANALYSIS

Expro can perform the following non-hydrocarbon analysis in oil/condensate:

Water content

Small amounts of water up to 3 wt% are determined by a coulometric Karl Fisher titration method.

Above 3 wt% the water content is determined by centrifuge (BS&W).

Salt in crude

Salt in crude is analysed either by a conductivity method based on IP 265, or a chloride titration method.

Sulphur content

Sulphur in crudes is an important sales parameter. The sulphur content is analysed by an ICP - AAS method.

Heavy metals; Nickel,Vanadium, Iron, Mercury

Heavy metals in crudes may poison catalysts present in the refinery process. They should be quantified before the crude enters the refinery. Heavy metals are analysed by a neutron activation method.

Polonium-210

Polonium is a radioactive isotope analysed by an alpha-spectrometry method or radon detector.

Other analysis commonly performed on crude oil/condensate include but, are not limited to:

- asphaltenes
- wax content
- density
- pour point

H_2S, RSH and COS

By absorption and potentiometric titration.