FUGRO
MIP-CPT-CONE

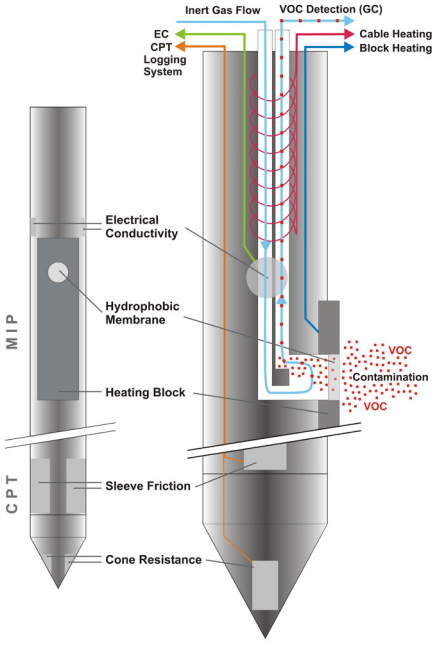
MIP-CPT (Membrane Interface Probe) is used for in situ screening of CHC (Chlorinated Hydrocarbons) and other VOC (Volatile Organic Compounds) in the saturated and vadose zone.

SCOPE OF APPLICATION

Risk assessments and remedial desk studies require detailed knowledge of the subsurface structure as well as the contaminant geometry and spread in both source and plume areas. In-situ investigation techniques are therefore essential for the vertical and horizontal delineation and characterization of contaminated sites.

CPT-CONE

Cone Penetrometer Testing (CPT) is known worldwide as a geotechnical investigation method to determine soil and groundwater characteristics in situ. Fugro has developed a variety of penetrometers, probes and samplers which are hydraulically pushed into the subsurface soil to obtain physical and chemical data. Lightweight detachable CPT units are offered for difficult access sites as well as large trucks and all-terrain vehicles with weights in the range 15 to 30 tonnes to provide penetration reaction.
For the purpose of environmental data collection the CPT cone is used in addition to the screening sensors. With the interpretation of tip resistance and friction ratio, CPT data give detailed lithological information of the subsurface soil.
Several sensors are available for direct measurement of organic compounds, being connected to the CPT cone. These probes are able to detect the vast majority of organic contaminants which are present in the subsurface.

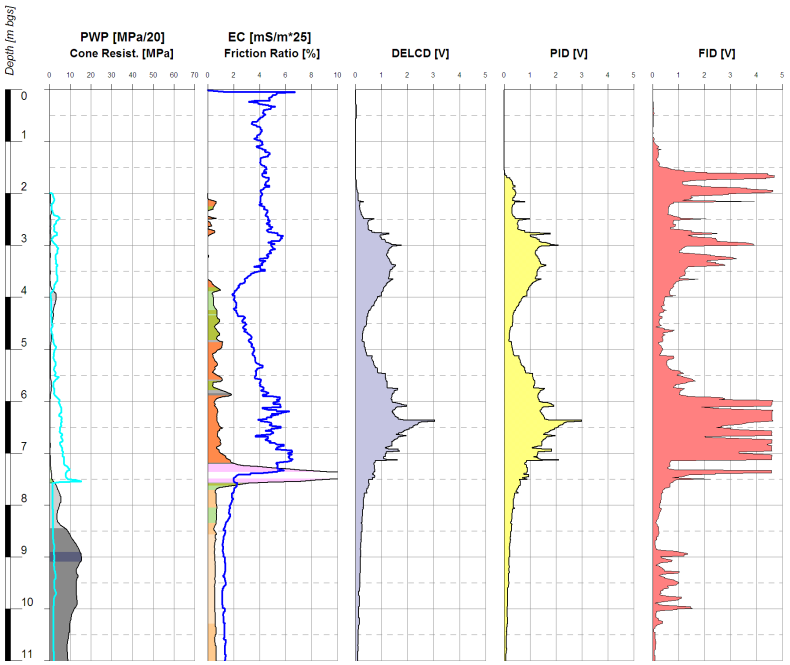


MIP-CPT layout.

MIP-CONE

The MIP cone detects VOC like PCE (tetrachloroethene), TCE (trichloroethene) and their biodegradation daughter products, also BTEX, MTBE and other volatile hydrocarbons via a heated membrane on the cone's sleeve. When heated, these compounds are being thermodesorbed and diffuse across the membrane. They are then transported by a carrier gas stream through capillaries in the MIP cable up to the lab unit in the vehicle where they are detected with a gas chromatograph equipped with a PID (Photo Ionisation Detector), FID (Flame Ionisation Detector) and a DELCD (Dry Electrolytic Conductivity Detector). This detector combination allows for selective specification of the contaminant type.

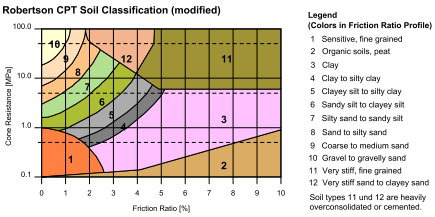
Equipped with a 10.6 eV UV lamp, the PID responds on unsaturated chemical compounds like chloroethenes or monoaromatic hydrocarbons with a lower ionisation potential compared to the excitation energy.
The FID detects organic carbon, while the DELCD is able to detect organic bonded chlorine.
Fugro's MIP units are equipped with a unique heated cable to increase sensitivity and reduce detector tailing effects caused by VOC condensation or retardation in the capillaries.
In addition to the CPT and MIP data, simultaneous electrical conductivity measurements are being performed. This enables the following data to be acquired in one push: Cone resistance, sleeve friction, friction ratio, electrical conductivity, porewater pressure, DELCD-, PID- and FID-logs.



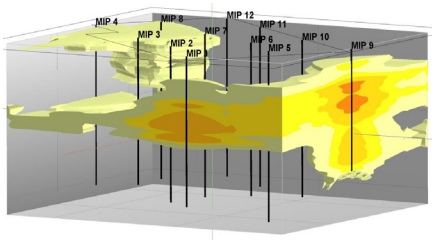
Resulting logs of a MIP-CPT investigation

DETECTION LIMITS

MIP sensitivity to different compounds strongly depends on the detector/ membrane conditions, the length of the cable and the membrane temperature, but also on the vapour pressure and other physical/chemical properties of the relevant compound. Average detection limits can be given for PCE (300 ppb), TCE (200 ppb), DCE (400 ppb), VC (500 ppb), Benzene (400 ppb), Toluene (300 ppb) and Xylenes (200 ppb) in groundwater. It has to be noted that these are orders of magnitude which can vary site specific.



Soil classification (after Robertson et. al, 1986).



3D presentation of the results of a MIP investigation.

Substance	PID	FID	DELCD
PCE	+++	+	+++
TCE	+++	+	+++
cDCE	++	+	++
tDCE	++	+	++
VC	+	+	+
TCA	-	+	+++
Benzol	+++	++	-
Toluol	+++	++	-
Ethylbenzol	+++	++	-
Xylole	+++	++	-

Sensitivity: +++ = high, ++ = medium, + = low, - = none

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