



FUGRO

MIP-HPT-CPT PROBE

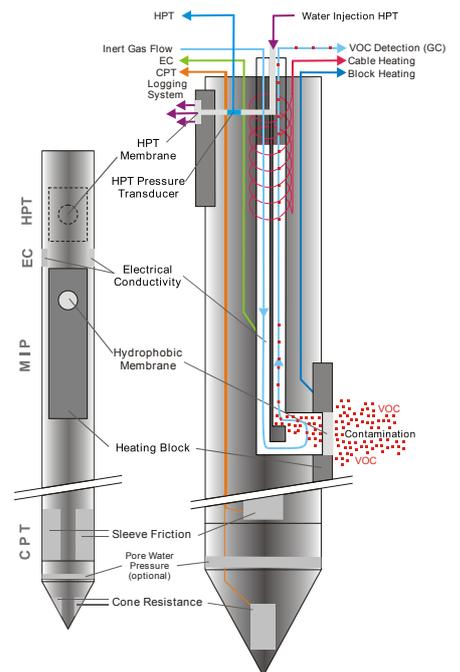
Our new combined MIP-HPT-CPT-probe joins three sensors in one compact probe-tip and sets a basis for a faster, more economical and efficient work progress.

APPLICATION

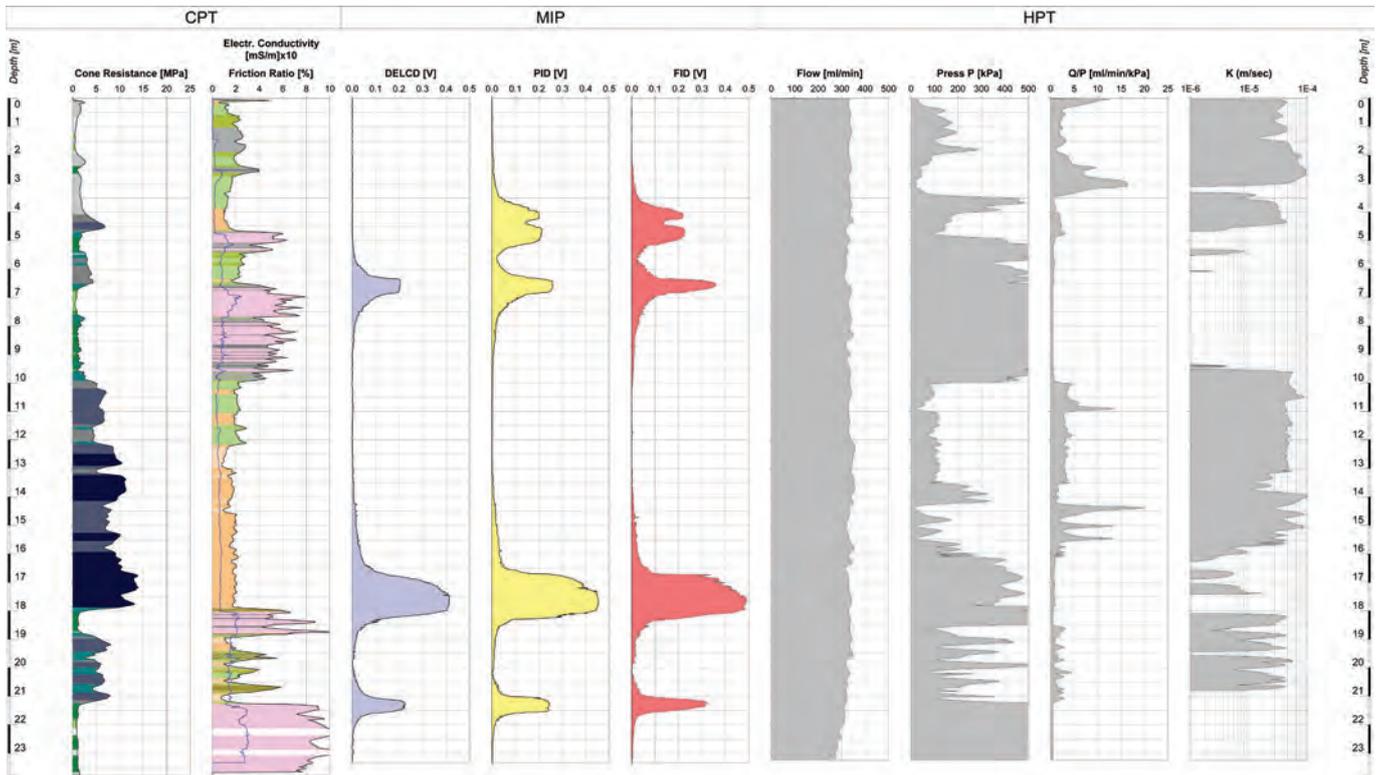
High-definition methods of subsurface investigation allow an improved understanding of the spatial distribution of contaminants and are key for the application of innovative approaches in remediation. Qualitative data are calibrated with quantitative data and analyses and processed to be incorporated in interpolation and forecast models. These models deliver the basis for a reliable risk assessment and remediation planning of subsurface contamination.

Multi-parameter probes are cost-effective tools which allow the real-time acquisition of several parameters with just one push.

Fugro, as global leader for in-situ direct sensing tools, is dedicated to the adaptation and further development of sensors for today's and future applications. The MIP-HPT-CPT probe is the latest development and has outstanding capabilities when it comes to detection of contaminants in soil and groundwater (MIP: Membrane Interface Probe), determining hydraulic conductivities (HPT: Hydraulic Profiling Tool) and providing a lithological classification and geotechnical data (CPT: Cone Penetration Test) simultaneously in just one push. In the past at least two separate pushes were necessary to acquire the same amount and volume of data.



MIP-HPT-CPT layout.



Membrane Interface Probe (MIP)

The Membrane Interface Probe is used for in-situ screening of CHC (Chlorinated Hydrocarbons) and other VOCs (Volatile Organic Compounds) in both the saturated and vadose zone. The MIP cone mobilises a fraction of the VOCs like PCE (Tetrachloroethene), TCE (Trichloroethene) and their biodegradation products with heat applied from the heating block of the cone (see Figure 1). When heated to 120 – 135°C, 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 truck where they are continuously detected with a gas chromatograph equipped with a PID (Photo Ionisation Detector), an FID (Flame Ionisation Detector) and a DELCD (Dry Electrolytic Conductivity Detector). This detector combination allows for selective specification of the contaminant type.

Fugro's MIP units are equipped with a heated cable to increase sensitivity and to reduce detector tailing effects caused by condensation or retardation. The combined use of MIP and CPT allows the joint identification and display of the vertical VOC-distribution and classified lithology.

Hydraulic Profiling Tool (HPT)

The Hydraulic Profiling Tool is designed to evaluate the hydraulic properties of the site subsurface. While the probe is advanced through the subsurface, water is injected at a constant rate Q (up to 4000 ml/min) through a screen on the side of the probe, opposite to the MIP membrane.

An in-line pressure sensor measures the pressure response p (kPa) of the soil/groundwater system against water injection. The water flows into the layers depending on the hydraulic properties of the soil. A low pressure response would indicate a large grain size, and the ability to easily transmit water. A high pressure response, however, would indicate a small grain size and the inability to transmit water. Pressure and flow rate are both logged versus depth.

The HPT tool can therefore be used to identify potential contaminant migration pathways. Similarly, it can help to identify zones for remedial material injection or provide qualitative guidance on how difficult injection may be in different zones of the formation.

Cone Penetrometer (CPT)

Cone Penetrometer Testing is a worldwide known geotechnical investigation method to determine soil and groundwater characteristics.

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 environmental data collection the CPT cone (see Figure 1) is basically used as an adapter to the screening sensors which provides subsurface stratigraphy through tip resistance and sleeve friction logs. By interpreting tip resistance and friction ratio, CPT data give detailed information of the subsurface lithology.

Recording electrical conductivity and other parameters

Next to the mentioned parameters the MIP-HPT-CPT probe records electrical conductivity (EC), slope and as an option the dynamic porewater pressure. A special feature is the combined processing of electrical conductivity data with data of the CPT-measurements. Fugro has developed an algorithm, which allows to determine the component of groundwater electrical conductivity as part of the detected bulk electrical conductivity. This information can be provided continuously and depth oriented with a resolution of 2 cm.

IN-SITU SLUG TESTS

By means of several slug tests, the site specific hydraulic behaviour (as derived from the HPT results) can be validated and translated into values of hydraulic conductivity (conversion of the relative HPT-signals into K-values). The in situ slug tests are conducted with a pneumatic toolkit. A screened interval of 1m length is brought to the target depth where it is uncovered from its protective casing.

The created micro well is purged to ensure an undisturbed connection to the soil formation. Afterwards the well is sealed by a valve at the surface and is pressurised with Nitrogen gas to temporary lower the groundwater table.

By opening the valve the groundwater is able to rise again. This rise is recorded by a pressure transducer inside the testing well. The rise is a function of the hydraulic parameters and geometry of the tested interval. On the basis of mathematical flow models the hydraulic conductivity of the interval can be calculated.

APPLICABLE DIRECT-PUSH SYSTEMS

MIP-HPT-CPT probings can be performed with a number of Direct-Push systems e.g. CPT-crawler, standard CPT-truck, CPT-mini-crawler, track-truck and stand-alone device.

Depending on the terrain and access conditions the right choice for a Direct-Push system is made. For Direct-Push work in the marine environment probing systems can be mounted on boats or pontoon in different combinations.

MIP-HPT-CPT
unit set up in
CPT truck.

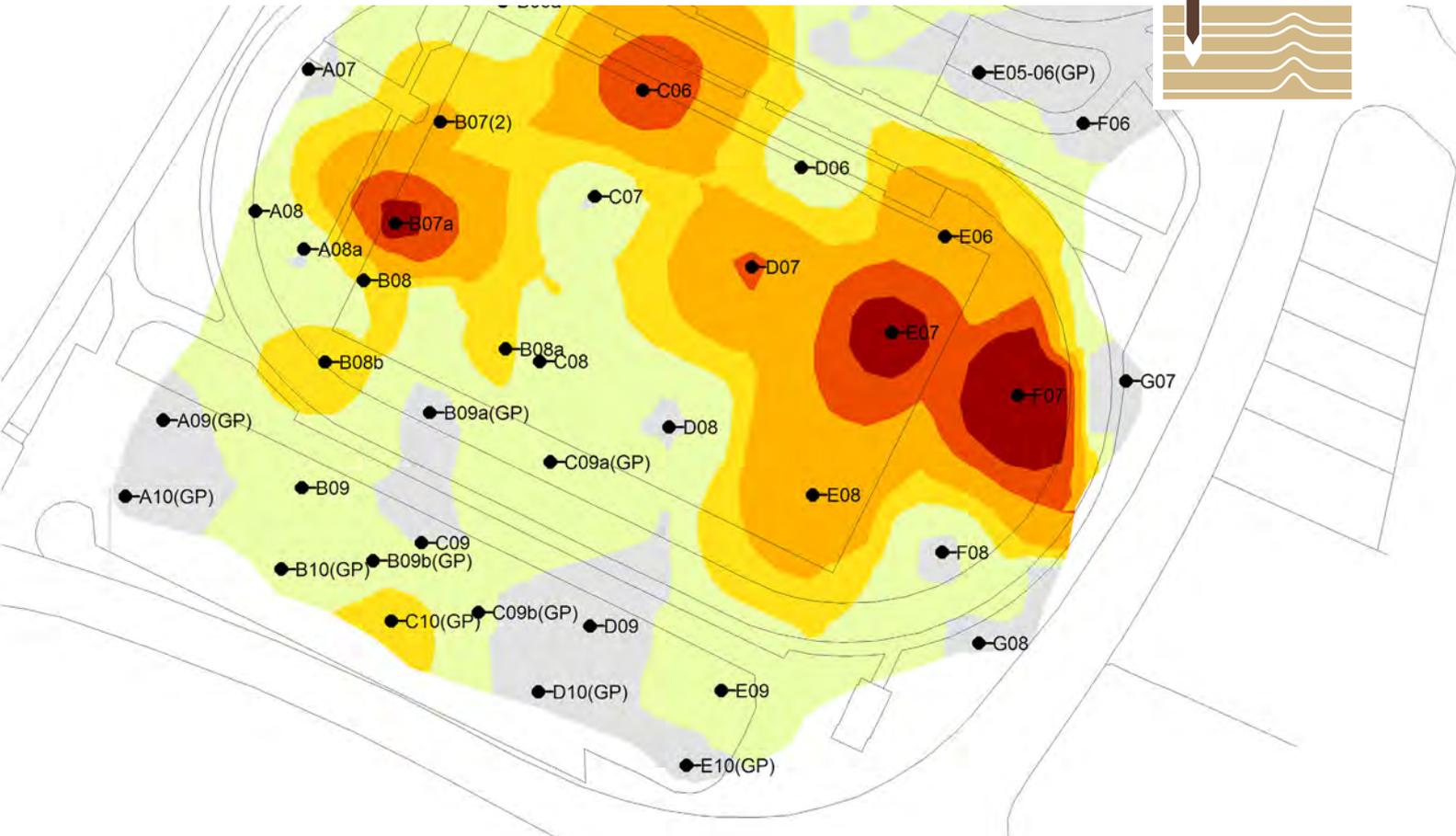


MIP-HPT-CPT
probe.



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

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



DATA PROCESSING

Data acquired in the field are transferred online and are processed by specialists using software developed by Fugro. CPT-data is processed by UNIPLOT, MIP-data by BLC. After processing, the data is displayed using Fugro's own visualization software package. The results are available to the client within a few hours. In addition we offer the 2D/3D-visualization of the processed field data. The datasets can be visualized as 3D-blockdiagrams, 3D-stacked isomaps, cross-sections and maps of maximum signals. Furthermore the retrieved MIP-, HPT- and CPT-data can be used in combination to compute mass sflow rates.

BENEFITS OF THE MIP-HPT-CPT PROBE

- Minimal-invasive investigation of the subsurface
- Simultaneous detection and measurement of Volatile Organic Compounds (VOCs), soil classification, hydraulic characteristics as well as electrical conductivity and dynamic porewater pressure
- Computation of hydraulical conductivities as well as mass flow rates by combined processing of the acquired datasets
- Efficient and economical acquisition of various datasets in one single push