

The Analysis of the FACT

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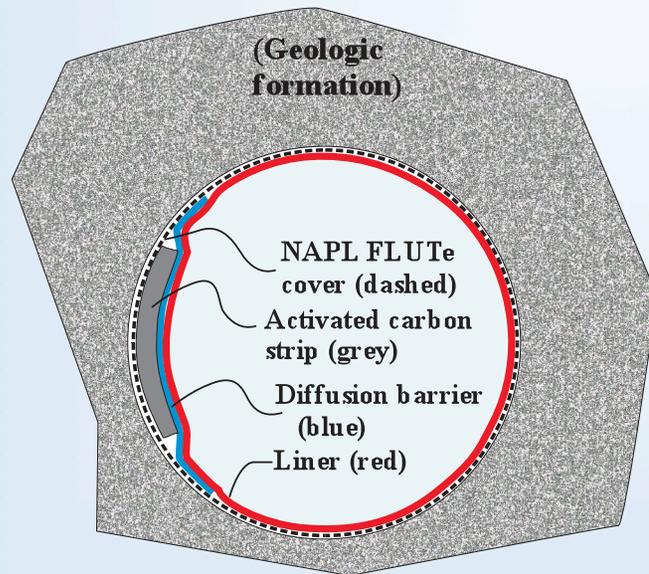
FLUTe

What is the FACT?*

- A strip of activated carbon felt on the exterior of a sealing flexible liner.
- The carbon felt is sandwiched between the NAPL FLUTE cover and a diffusion barrier with the diffusion barrier against the liner. The liner presses the FACT firmly against the borehole wall and the diffusion barrier isolates the carbon from contact with the liner.
- The FACT wicks by diffusion the contaminants from the formation.
- The exterior cover of the FACT is a color reactive thin film sensitive to NAPLs. See the “NAPL FLUTE” at www.flut.com.
- The purpose of the FACT is to obtain a replica of the dissolved phase of the contaminant distribution in the formation, the outer cover reacts to NAPL.
- However, the FACT works equally well in the vadose zone.

* FLUTE US patent no. 7,896,578

The geometry of the FACT system



Carbon felt in the FACT



Color striped material is the NAPL FLUTE cover

How does the FACT work?

- The contaminants in the fractures and pore space of the formation diffuse through the exterior cover and are tightly adsorbed on the carbon.
- The NAPL FLUTe covering only reacts to the pure NAPL.
- The carbon strip and its NAPL FLUTe covering are inverted from the borehole for assessment of the relative distribution of contamination in the formation.
- Stains on the NAPL FLUTe cover are associated with a tape measure laid next to the cover and photographed.

This rest of this presentation describes how the carbon felt is analyzed.

The FACT procedure

1. The liner system is manufactured by FLUTe for hole depth and diameter.
2. The liner system can be installed in the borehole by the customer or FLUTe.
3. The liner is everted into the borehole from a shipping reel.
4. After 1.5-2 weeks (2-5 days in the vadose zone) the liner is removed from the borehole by inversion of the liner.
5. The NAPL cover and FACT are removed from the inverted liner.
6. The cover is examined for depths of staining due to the pure product NAPL.
7. The carbon is sectioned and sent to the laboratory for identification of the relative concentrations adsorbed in the carbon.
8. It is recommended that the liner be used to perform a FLUTe transmissivity profile of the borehole to measure the location and the flow capacity of each flow feature.

The intent of the carbon analysis

- The carbon wicks contaminants from both the fractures and the pore space of the formation.
- Because the carbon strip is continuous, the contamination in the carbon is due to both sources and does not depend on core recovery or the known location of the fractures.
- Therefore, the entire carbon strip should be analyzed in order to locate the depths of contamination in the formation.
- The cost of analysis depends on the number of samples analyzed, not on the size or length of carbon in each sample.
- Therefore, the longer each section that is submitted for analysis, the cost of analysis is minimized. Again, the entire strip should be analyzed.

The preparation of the carbon felt for analysis

1. The carbon felt with the NAPL cover and diffusion barrier are cut from the cover after the cover on the FACT has been labeled for depth intervals.
2. The FACT with the cover and diffusion barrier can then be rolled to move it to a convenient location for sectioning.
3. The FACT (a sandwich of the cover, carbon and diffusion barrier) is then cut into the appropriate sections (6 inches to 3 ft or more if desired).
4. The FACT seams are then cut away and the carbon strip removed.
5. The carbon strip can be cut in half lengthwise.
6. The one half can be kept in a labeled bottle filled with DI water for further sectioning and analysis if desired. The top end (as located in the borehole) can be cut at an angle in order to preserve its orientation in the borehole.
7. The second half can be inserted into a bottle with either DI water or a suitable volume of methanol as prescribed by the analytical lab. It should be labeled for the depth interval in the borehole. This is the sample to be analyzed.
8. The sample to be analyzed is sent to the laboratory for analysis using a GCMS.

The use of the results

1. The results of the analysis (contaminant mass/gm of carbon) can be plotted to identify the major intervals of contamination.
2. If desired, the section preserved in DI water can be subdivided for a more explicit location of the contaminant source. Comparison with the transmissivity profile can be helpful in understanding whether the contamination is in the fracture flow or in the pore space of the formation.
3. If a multi-level sampling system, such as a Water FLUTE, is planned for the borehole, the FLUTE transmissivity profile and the FACT results can be used to define the appropriate sampling intervals for ground water sampling and head measurements.

Additional guidance

- FLUTE provides a detailed written procedure for sectioning of the FACT in order to avoid the risk of cross contamination.
- However, the contaminants are so strongly bound to the carbon that exposure to air for two days only reduces the contaminant levels by half. Submergence in DI water for two days produced no detectable loss. This is based on detailed lab analysis by the Danish Technical University (see the M. Beyer 2013 thesis included in the references.)
- An additional reference on the field application of the method is available (Broholm, et al 2015)
- For additional information on the method see the FLUTE website, www.flut.com or contact FLUTE at 505-852-0128)

References:

- Monique Beyer Masters thesis
<http://flut.com/resources/Publications/Monique-Beyer-FACT-thesis-DTU-3-9-12--reduced-size.pdf>
- FLUTe publication on FACT system
<http://flut.com/resources/Publications/The-FLUTe-FACT-technique.pdf>
- Abstract on use in Denmark
<http://flut.com/resources/Publications/High-Resolution-Hydraulic-Profiling-and-Groundwater-Sampling-Using-FLUTe-System-in-Denmark.pdf>
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- Video on high resolution FLUTe methods: <http://flut.com/>