

The FACT System and How It is Used

The FACT (FLUTE Activated Carbon Technique) is a method developed by FLUTE for mapping the distribution of contamination in the pore space and fractures of a borehole wall. The technique incorporates a 0.125 x 1.5 inch strip of activated carbon felt into the typical hydrophobic cover of the NAPL FLUTE system normally used for mapping the subsurface presence of a wide variety of NAPLs. The NAPL FLUTE cover is typically installed into a borehole on the outside of an everting FLUTE blank liner. The installation of a NAPL FLUTE cover with the added activated carbon strip allows one to draw, by diffusion, the dissolved contaminants from the formation into the activated carbon. Recovery of the liner by inversion prevents the carbon from contact with any other portion of the borehole wall. At the surface, the carbon is then sectioned for chemical analysis. With the combination of the NAPL cover and the FACT, one can map both the NAPL and the dissolved phase of many other contaminants.

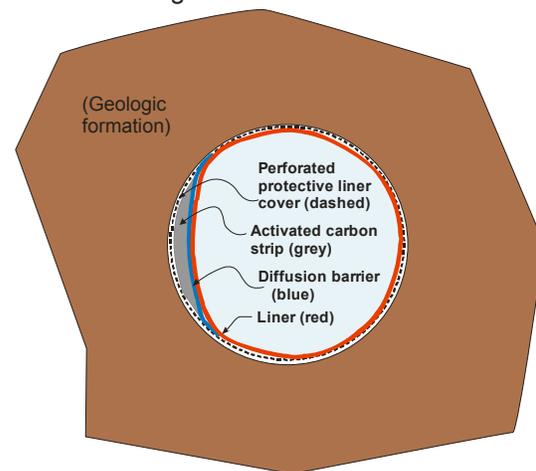
The FACT felt geometry is shown in the drawing, Fig. 1. The felt is located on the inside surface of the ~1 mil thick hydrophobic cover. Between the carbon and the liner is located a thin flexible diffusion barrier that isolates the carbon from the liner. The barrier is stitched to the cover on both sides of the carbon strip. The liner presses the diffusion barrier, carbon felt and perforated cover firmly against the borehole wall. The

Fig. 2. The carbon felt between the cover and the diffusion barrier



Fig. 1. FACT Components

Borehole cross section showing carbon felt absorber



cover material is usually dye striped on the outside surface for the purpose of mapping the presence of the NAPL by developing a stain on the inside surface of the cover. The photo, Fig. 2, shows a FACT carbon felt strip sandwiched between the lower silver colored diffusion barrier and the upper striped, white NAPL FLUTE cover.

Once the carbon felt sandwich is removed from the hole, the liner is removed from outside of the inverted cover and the carbon felt is sectioned as desired and placed in sample bottles with methanol. The methanol extracts the contaminant from the carbon, and the methanol is analyzed in the lab. The procedure is very similar to

analysis of a soil sample. Several labs have experience analyzing the carbon felt.

The FACT method was first tested in Denmark in 2010 where it was compared to measurements performed in contaminated sediments using both the Geoprobe MIP and soil sample analysis. The NAPL/FACT liners were actually installed through Geoprobe rods. The graph (Fig.3) shows the excellent comparison with the MIP results. The comparison was equally good with the soil samples. The FACT results are in terms of contamination per gram of carbon and not directly related to the concentration in the formation. Rather, the contaminant concentration in the carbon is more directly related to the concentration gradient and diffusion coefficient of the contaminant in the formation pore or fracture space. In other words, the carbon concentration is a measure of the availability of the contaminant. The carbon is typically analyzed for the concentrations of individual species. To date, most assessments have been for NAPLs.

The protection provided by the NAPL FLUTE cover and the brief exposure (a few seconds) to the resident borehole water during the eversion of the carbon felt into place against the borehole wall greatly reduces any concern about the contact of the system with the borehole water. The borehole water is usually pumped from the hole as the liner is everted. The exposure time during the inversion of the liner during its removal is also brief. The FACT is typically left in place for 48 hr. to allow the diffusion process from the formation into the carbon. A diffusion calculation shows that two days is long enough to “see” about 0.5cm into the borehole wall with a pore space of 20%. Obviously, it is wise to seal the borehole with the FLUTE liner system as quickly as possible after the hole is drilled to minimize cross connection and the effect of the borehole water on the pore water in the formation.

Whereas the first rigorous test of the method was done in Denmark in soil, the FACT method is uniquely easy to use in fractured rock which is where this method has been more frequently used. A master’s thesis is available by Monique Beyer of the Danish Technical Univ. which is a rigorous assessment of the FACT analysis method and its use for a fractured rock site. There is very little loss in the handling of the carbon. Subsequent papers are in preparation by those participating in the same project which will be comparing the use of the FLUTE NAPL/FACT, the Water FLUTE, and other methods in a limestone formation in Denmark. Ask FLUTE (info@flut.com) for a copy of the Beyer Thesis. For more information, call FLUTE at 505-455-1300, or email info@flut.com. Other FLUTE methods are described on the web site www.flut.com. Note there is no “e” in the web address.

Fig. 3. Comparison of MIP with FACT

