

Phase III Sample – F3 Refinery Residue

F3 is a refinery product that is a viscous liquid at room temperature. It can vacuum distilled to produce F3 vacuum residue or deasphalted to produce an F3 asphaltene sample. In Phase III all three are available, although F3 vacuum residue and F3 asphaltenes may be easier to work with as solids. The analytical properties for F3 vacuum residue have not been measured, however, our understanding of similar vacuum residues indicates it should be a reasonable starting material from which to try and make a carbon fibre input feedstock and one worth exploring.

Analytical Properties

Property	F3 Sample ¹	F3 Vacuum Residue	F3 Asphaltenes	Unit
Available in Phase III	Yes	Yes	Yes	
State at room temperature	Liquid	Glassy solid*	Solid	
Carbon	85.5	*	87	% mass
Hydrogen	9.9	*	6.4	% mass
Nitrogen	0.8	*	1.7	% mass
Sulfur	2.8	*	3.2	% mass
Oxygen	0.6	*	*	% mass
Aluminum	56	*	*	ppm
Calcium	3	*	51	ppm
Iron	163	*	187	ppm
Molybdenum	11	*	*	ppm
Nickel	60	*	272	ppm
Silicon	71	*	*	ppm
Sodium	16	*	<16	ppm
Titanium	6	*	*	ppm
Vanadium	100	*	362	ppm
Asphaltene (pentane insoluble)	12	*	>80**	% weight
Asphaltene (heptane insoluble)	8	*	70.6	% weight
Ash Content	0.2	*	0.5	% weight
Micro Carbon Residue	22.5	*	70.1	% weight
Toluene Insoluble	1.2	*	6.4	% weight
Quinoline Insoluble	0.2	*	0.8	% weight

Softening Point	30.2	*	>160 °C**	°C
5% cut point (by mass)	407	*	494	°C
10% cut point (by mass)	436	*	529	°C
Fraction <524 °C	32.7	*	9	% mass
Fraction + 720 °C	25	*	46	% mass

*Properties to be measured by CFGC Phase III teams

**Estimated

¹ The F3 sample was labelled L3 in Phase II

Preparation of F3 Samples

Sample origin	Athabasca bitumen
Processing steps for F3	<ol style="list-style-type: none"> 1) Bitumen is partially de-asphalted with solvent 2) Distillation to remove diluent and gas oil fractions 3) Thermal cracking of vacuum residue with hydrogen addition in the presence of catalyst, which removes sulfur and vanadium. The light components are evaporated from the liquid product. The F3 sample is the high-boiling material remaining after stripping.
Processing steps for F3 Asphaltenes	L3 Asphaltenes are precipitated by the addition of an n-alkane mixture to F3.
Maximum Temperature:	<p>F3: Up to 440°C for tens of minutes</p> <p>Asphaltene isolation is at < 200°C, however, this occurs after F3 production which reaches temperatures of up to 440 °C for tens of minutes.</p>

Sample F3 Treatment

Sample F3 and its derivatives require further treatment to be a potential feed for carbon fibre. Treatment options include heat or chemical treatment. F3 Asphaltenes were prepared to give a higher viscosity feed material that is enriched in highly aromatic components.

Sample F3 Commerciality

Sample F3 is a commercial product and will be a commercial product in 2027 and beyond.

Note: There is no commercial asphaltene production in Alberta today and no new facilities have been sanctioned. For commercial scale production of modified F3 feedstocks, such as F3 Asphaltenes, a new facility would need to be built. Similarly, for F3 vacuum residue a distillation operation would need to be constructed.