Phase III Sample – F1 – Bitumen and Derivatives

Bitumen is the naturally occurring heavy oil found in the oil sands. The properties in the table below are for a) bitumen, b) vacuum residue (prepared by distillation of bitumen), and c) asphaltenes (prepared by solvent deasphalting of bitumen). In Phase III, **only vacuum residue and asphaltenes** will be offered as a potential starting point for making carbon fibre. Treatment steps will vary depending on which sample is used. In the Phase III application, please indicate which sample you prefer (F1 Vacuum Residue or F1 Asphaltenes) and how much sample you will require.

Analytical Properties

Property	F1 Bitumen	F1 Vacuum Residue	F1 Asphaltenes[1]	Unit
Available in Phase III	**No**	**Yes**	**Yes**	
State at room temperature	Viscous liquid	Glassy solid	Solid	
Carbon	84.4	*	81.4	% mass
Hydrogen	10.3	*	8.70	% mass
Nitrogen	0.5	0.7	1.0	% mass
Sulfur	4.9	6.4	7.6	% mass
Oxygen	*	*	1.15	% mass
Iron	6	10	14	ppm
Nickel	65	110	336	ppm
Vanadium	221	389	851	ppm
Asphaltene (C5 insoluble)	18.5	32.2	82.7	% mass
Asphaltene (C7 insoluble)	10.7	18.2	66.4	% mass
Ash Content	0.2	*	0.2	% weight
Micro Carbon Residue	14.7	24.8	38.4	% mass
Toluene Insoluble	*	*	0.06	% weight
Quinoline Insoluble	*	*	0.1	% weight
Softening Point	<50	80	149	°C
5% cut point	291	535	*	°C
10% cut point	330	559	*	°C
Fraction <524 °C	43	3	*	% weight
Fraction + 720 °C	25	46	*	% weight

*characterization data not acquired

[1]In Phase II a similar sample was S1

Preparation

Sample origin	Athabasca bitumen
Processing steps	Bitumen is extracted using the steam assisted gravity drainage process. Bitumen is then diluted using a light hydrocarbon to an average API of 21°.
	Vacuum residue is prepared by heating bitumen first under atmospheric conditions and then under vacuum and distilling off all volatile material. The remaining solid that cannot be distilled is vacuum residue.
	Asphaltenes are precipitated by addition of an n-alkane mixture to bitumen.
Maximum Temperature:	Bitumen extraction: < 250°C
	Vacuum residue preparation: Commercial operation up to 390 °C for short times under vacuum
	Asphaltene isolation: < 200°C
References	Keesom, W., Gieseman, J. Bitumen Partial Upgrading 2018 Whitepaper AM0401A, Alberta Innovates 2018, https://albertainnovates.ca/app/uploads/2018/07/Bitumen-Partial-Upgrading-March-2018-Whitepaper-2433-Jacobs-Consultancy-FINAL_04July.pdf Gray, M.R. Upgrading of Oilsands Bitumen, University of Alberta Press, 2015, Chapters 6 and 8.

Commerciality

Availability of bitumen or bitumen derived feedstocks is important for commercial carbon fibre production. Below is a description of the availability of each type of feedstock described in this data sheet. Although a feed is not commercial in the near term, strong success in Phase III could accelerate the building of a commercial facility.

Bitumen	Is a commercial product produced in millions of barrels per day.
Vacuum Residue	Is currently produced in Alberta upgraders and refineries. It is also known as vacuum tower bottoms. A vacuum distillation system is a basic refinery apparatus and can be easily set up. Vacuum tower bottoms will be a commercial product in 2027 and beyond.

Asphaltenes	There is no commercial production of low-solids content asphaltene in Alberta today or new facilities sanctioned. There is not expected to be a commercial supply by 2027. Current estimates are for commercial asphaltene production to be available sometime in the 2030 – 2035 timeframe.