

## Supplementary Materials

Article

# Industrial Investigation of the Combined Action of Vacuum Residue Hydrocracking and Vacuum Gas Oil Catalytic Cracking While Processing Different Feeds and Operating under Distinct Conditions

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**Table S1.** Composition of the partially blended fuel oil (PBFO)

No	Date	HCO in PBFO, %	LCO in PBFO, %	SLO in PBFO, %	VTB in PBFO, %
1	11.04.2022	23.0	0.0	0.4	76.6
2	23.05.2022	24.8	0.0	6.6	68.5
3	30.05.2022	16.2	0.0	6.4	77.5
4	06.06.2022	17.4	0.0	6.5	76.1
5	13.06.2022	16.4	0.0	4.2	79.4
6	20.06.2022	20.1	0.0	4.8	75.0
7	27.06.2022	24.6	0.0	5.3	70.1
8	4.07.2022	27.5	0.0	6.1	66.4
9	11.07.2022	26.9	0.0	5.8	67.2
10	05.09.2022	30.6	1.6	5.5	62.3
11	03.10.2022	0.0	42.1	10.2	47.7
12	28.11.2022	35.1	0.0	11.0	53.9
13	03.01.2023	24.9	13.6	2.4	59.0
14	30.01.2023	26.0	11.2	2.9	59.9
15	06.02.2023	24.9	11.3	6.7	57.2
16	13.02.2023	38.1	0.0	6.4	55.5
17	20.02.2023	37.4	0.0	4.4	58.2

18	27.02.2023	36.9	0.0	4.8	58.3
19	06.03.2023	43.2	0.0	5.4	51.4
20	13.03.2023	42.3	0.0	6.6	51.1
21	20.03.2023	28.4	5.9	9.9	55.8
22	27.03.2023	27.9	13.8	5.5	52.7
23	03.04.2023	40.3	0.0	9.3	50.5
24	10.04.2023	44.5	0.0	7.8	47.7
25	18.04.2023	52.6	0.0	0.0	47.4
26	24.04.2023	75.6	0.0	0.0	24.4
27	28.04.2023	52.2	0.0	0.0	47.8
28	09.05.2023	33.7	0.0	11.3	55.0
29	15.05.2023	34.1	0.0	10.8	55.1
30	22.05.2023	52.2	0.0	7.4	40.4
31	29.05.2023	45.5	0.0	7.9	46.6
32	05.06.2023	45.9	0.0	10.6	43.5
33	12.06.2023	31.4	0.0	12.1	56.6
34	19.06.2023	33.0	0.0	11.3	55.7
35	26.06.2023	33.7	0.0	8.0	58.2
36	03.07.2023	19.1	0.0	3.1	77.7
37	10.07.2023	14.1	0.0	13.0	73.0
38	17.07.2023	11.7	0.0	3.9	84.4
39	24.07.2023	16.1	0.0	10.6	73.4
	min	0.0	0.0	0.0	24.4
	max	75.6	42.1	13.0	84.4
	average	31.5	2.6	6.5	59.4

**Table S2.** Properties of diluents used to blend with H-Oil VTB obtained at very low severity (WABT of 405°C)

	FCC SLO	FCCPT diesel	FCC LCO	FCC HCO
Sim.Dis, % wt.	ASTM D-2887			
IBP	196	167	138	196
5	321	221	177	251
10	341	252	195	267
20	366	287	207	281
30	383	309	220	296
40	399	323	230	306
50	413	336	232	321
60	428	347	247	332
70	444	358	253	344
80	463	268	258	358
90	487	382	272	379

95	506	392	282	397
FBP	539	419	319	446
Density at 15°C, g/cm <sup>3</sup>	1.1146	0.8848	0.9412	1.0336
Kw-characterization factor*	9.63	11.65	10.29	9.89
Viscosity at 80°C, mm <sup>2</sup> /s	56.7	2.85	1.35	2.91
Engler specific viscosity at 80°C, °E	7.65			
Refractive index at 20°C	1.6489	1.4953	1.5380	1.5963
Molecular weight, g/mol	297	253	160	218
Aromatic ring index (ARI)	3.6	1.1	1.5	2.4

\*Note: Kw-characterization factor is calculated by the expression:

$$Kw = \frac{\sqrt[3]{1.8 \left[ \frac{T_{10} + T_{30} + T_{50} + T_{70} + T_{90}}{5} + 273.15 \right]}}{d_{15}} \quad \text{eq.S1 (ref. S1)}$$

where,

T10 – boiling point of 10% of evaporate according to the HTSD (ASTM D7169), °C;

T30 – boiling point of 30% of evaporate according to the HTSD (ASTM D7169), °C;

T50 – boiling point of 50% of evaporate according to the HTSD (ASTM D7169), °C;

T70 – boiling point of 70% of evaporate according to the HTSD (ASTM D7169), °C;

T90 – boiling point of 10% of evaporate according to the HTSD (ASTM D7169), °C.

Ref. S1. Gharagheizi, F., Fazeli, A. Prediction of the Watson characterization factor of hydrocarbon components from molecular properties. QSAR Comb. Sci. 2008, 27, 6, 758 – 767, <https://doi.org/10.1002/qsar.200730020>.

**Table S3.** Hydrodeasphaltization extent (HDAs), vacuum residue (540°C+) conversion, hydrodemetallization extent (HDM), and reaction temperatures in both reactors, and reactor temperature  $\Delta T$

No	Date	HDAs(C <sub>5</sub> ), HDAs(C <sub>7</sub> ),		H-Oil Net	HDM,	LHSV,	WABT,	T-	T-	R-	R-
		%	%	conversion,				R1001,	R1002,	1001	1002
				wt. %	%	h <sup>-1</sup>	°C	°C	°C	$\Delta T$ , °C	$\Delta T$ , °C
1	11.04.2022	50.0	60.1	62.0	50.0	0.14	414.5	414	415	54	52
2	23.05.2022	75.4	69.9	71.6	79.4	0.17	421.5	419	424	65	51
3	30.05.2022	69.0	66.3	69.7	77.7	0.18	421.5	419	424	67	43
4	06.06.2022	69.6	57.4	70.8	82.0	0.18	421.5	420	423	68	41
5	13.06.2022	71.0	64.3	71.6	82.0	0.17	421.5	421.5	421.5	68.5	35.5
6	20.06.2022	68.0	67.0	74.7	88.3	0.17	424.5	424.5	424.5	74.5	39.5
7	27.06.2022	75.2	70.3	75.5	87.1	0.17	425	425	425	75	41
8	04.07.2022	79.7	80.9	76.5	89.0	0.18	428	428	428	78	41
9	11.07.2022	81.4	79.6	77.4	89.5	0.18	428	428	428	77	40
10	05.09.2022	67.5	55.2	77.0	85.2	0.19	431	430	432	91	40
11	03.10.2022	82.9	80.5	78.0	89.9	0.2	430	429	431	80	34
12	28.11.2022	74.4	73.4	82.7	90.0	0.17	431	430	432	84	43
13	03.01.2023	66.3	69.7	73	81.8	0.21	430	430	430	84	41
14	30.01.2023	65.3	64.0	77	82.3	0.20	430	430	430	79	41
15	06.02.2023	74.4	74.6	79.6	91.6	0.16	430	430	430	85	43
16	13.02.2023	81.7	80.2	84.9	95.3	0.16	430	430	430	80	44
17	20.02.2023	77.9	76.0	82.1	93.9	0.15	430	430	430	79	41
18	27.02.2023	85.0	78.2	83.4	93.4	0.14	430	430	430	80	43
19	06.03.2023	82.2	79.9	84.5	94.4	0.15	430	430	430	76	43
20	13.03.2023	83.8	78.2	87.0	94.6	0.13	430	430	430	82	47
21	20.03.2023	78.9	76.3	85.3	90.6	0.15	430	430	430	81	46
22	27.03.2023	81.0	76.8	86.2	93.1	0.13	430	430	430	86	47
23	03.04.2023	87.5	84.1	91.7	96.6	0.12	430	430	430	83	46
24	10.04.2023	84.3	84.8	90.5	94.2	0.13	430	430	430	88	53
25	18.04.2023	81.7	84.8	88.6	94.4	0.16	430	430	430	90	52
26	24.04.2023	87.3	82.2	89.4	92.0	0.15	430	430	430	91	50
27	28.04.2023	84.7	82.9	87.1	90.2	0.15	430	430	430	96	55
28	09.05.2023	78.6	75.5	86.6	92.0	0.13	430	430	430	92	48
29	15.05.2023	76.9	69.4	86.2	91.5	0.13	430	430	430	72	36
30	22.05.2023	75.1	72.2	85.6	90.1	0.13	430	430	430	60	33
31	29.05.2023	74.9	71.0	85.4	89.9	0.13	430	430	430	61	33
32	05.06.2023	76.8	73.2	86.0	84.6	0.12	430	430	430	85	45
33	12.06.2023	70.5	66.1	85.3	83.9	0.12	430	430	430	90	51
34	19.06.2023	75.4	74.9	86.1	89.2	0.12	430	430	430	92	50
35	26.06.2023	72.5	71.1	83.8	86.3	0.13	430	430	430	88	50
36	03.07.2023	45.1	29.5	53.6	39.2	0.13	405	408	402	56	24
37	10.07.2023	56.0	49.9	54.3	59.1	0.13	405	408	402	64	21
38	17.07.2023	56.0	38.7	52.7	62.5	0.13	405	408	402	70	22

39	24.07.2023	53.3	51.9	51.8	65.8	0.13	405	408	402	66	21
40	11.08.2023	57.8	54.2	56.2	78.3	0.11	405	408	402	72	25

Note: The meaning of designations used in Table S3 is following:

HDA<sub>s</sub>(C<sub>5</sub>) = hydrodeasphaltization of C<sub>5</sub> asphaltenes, %;

HDA<sub>s</sub>(C<sub>7</sub>) = hydrodeasphaltization of C<sub>7</sub> asphaltenes, %;

HDM = hydrodemetalation, %;

LHSV = Liquid hourly space velocity, h<sup>-1</sup>;

WABT = Weight average bed temperature, °C;

T-R1001 = Temperature of first ebullated bed reactor (R-1001), °C;

T-R1002 = Temperature of second ebullated bed reactor (R-1001), °C;

R-1001 ΔT = ΔT of first ebullated bed reactor, °C;

R-1002 ΔT = ΔT of second ebullated bed reactor, °C

The reactors R1001, and R1002 are both ebullated bed reactors, working in series as depicted in Figure 1.

**Table S4.** Properties of H-Oil feed

	Date	Feed D15	Feed T50	Feed MW	Feed C5 asp	Feed C7 asp	Feed Res	Feed ARO	Feed Sat.	Feed Kw	Feed Sulphur	Recycle wt.% of feed	FCC SLO in Feed wt.% of feed	Feed CII (C5)	Feed CII (C7)
No		g/cm <sup>3</sup>	°C	g/mol	wt.%	wt.%	wt.%	wt.%	wt.%		wt.%				
1	11.04.2022	1.0269	623	722	19.7	17.2	2.5	61.6	18.7	11.42	2.68	0.00	5.76	0.62	0.56
2	23.05.2022	1.0146	619	717	19.3	13.8	5.5	58.8	22.0	11.54	2.41	0.00	11.76	0.70	0.56
3	30.05.2022	1.0143	613	700	18.3	12.7	5.6	59.7	22.0	11.52	2.21	0.00	9.33	0.68	0.53
4	06.06.2022	0.9911	602	682	18.0	9.3	8.7	52.4	29.6	11.74	2.25	0.00	7.99	0.91	0.64
5	13.06.2022	0.9970	600	673	17.6	11.8	5.8	54.9	27.5	11.66	2.23	0.00	7.52	0.82	0.65
6	20.06.2022	0.9911	577	615	13.2	9.6	3.6	57.1	29.6	11.63	2.28	0.00	10.82	0.75	0.65
7	27.06.2022	0.9996	589	642	15.7	10.6	5.1	57.7	26.6	11.58	2.43	0.00	8.47	0.73	0.59
8	04.07.2022	0.9826	579	625	16.1	11.9	4.2	50.9	33.0	11.74	2.48	0.00	7.99	0.97	0.81
9	11.07.2022	0.9977	581	622	15.1	10.5	4.6	57.6	27.3	11.57	2.45	0.00	7.99	0.74	0.61
10	05.09.2022	1.0056	597	660	19.2	11.9	7.3	56.2	24.6	11.55	2.76	0.00	8.42	0.78	0.58
11	03.10.2022	1.0000	549	545	15.9	9.76	6.1	57.6	26.5	11.40	2.58	0.00	7.20	0.74	0.57
12	28.11.2022	1.0002	590	644	17.6	12.1	5.5	56.0	26.4	11.58	2.52	0.00	8.51	0.79	0.63
13	03.01.2023	1.0080	600	667	17.0	13.6	3.3	59.1	23.9	11.53	2.48	0.00	5.40	0.69	0.60
14	30.01.2023	1.011	601	668	18.4	12.5	5.9	58.5	23.1	11.51	2.43	0.00	11.68	0.71	0.55
15	06.02.2023	1.0028	594	653	15.2	11.0	4.3	59.2	25.5	11.57	2.00	2.51	16.56	0.69	0.57
16	13.02.2023	1.0027	577	609	15.9	9.8	6.1	58.5	25.6	11.49	1.96	5.06	12.65	0.71	0.55
17	20.02.2023	1.002	581	619	16.7	11.1	5.5	57.5	25.8	11.52	2.05	6.77	6.34	0.74	0.59
18	27.02.2023	1.002	581	620	20.1	11.2	8.9	53.9	26.0	11.52	2.07	8.34	7.23	0.85	0.59
19	06.03.2023	0.9967	572	600	16.3	10.8	5.5	56.1	27.6	11.54	1.99	8.09	6.28	0.78	0.62
20	13.03.2023	1.0000	559	567	15.6	9.5	6.0	57.9	26.5	11.44	1.82	11.86	9.37	0.73	0.56
21	20.03.2023	1.0055	577	608	15.8	9.9	5.9	59.6	24.7	11.46	2.23	3.05	15.78	0.68	0.53
22	27.03.2023	1.0017	579	615	17.5	12.2	5.4	56.6	25.9	11.51	2.30	12.27	7.84	0.77	0.61
23	03.04.2023	1.010	584	623	18.6	12.6	6.0	58.0	23.4	11.45	2.26	17.74	5.86	0.72	0.56
24	10.04.2023	1.0164	573	592	15.5	11.0	4.4	63.1	21.5	11.32	2.07	15.75	14.78	0.59	0.48

25	18.04.2023	0.9616	511	482	12.5	8.9	3.6	44.4	43.1	11.67	2.07	7.65	0.00	1.25	1.08
26	24.04.2023	0.9596	513	487	14.1	8.0	6.2	41.7	44.2	11.70	2.08	7.79	0.00	1.40	1.09
27	28.04.2023	0.9721	529	514	16.2	10.7	5.6	46.0	37.7	11.63	2.75	8.51	4.67	1.17	0.94
28	09.05.2023	1.0061	552	549	15.8	11.2	4.7	59.7	24.5	11.34	2.45	9.36	15.24	0.68	0.55
29	15.05.2023	1.0132	594	647	19.4	13.0	6.4	58.3	22.4	11.45	2.88	8.01	11.63	0.72	0.55
30	22.05.2023	1.0196	595	646	18.6	14.9	3.8	60.8	20.6	11.38	2.80	10.14	8.73	0.64	0.55
31	29.05.2023	1.0180	590	634	18.3	13.1	5.2	60.7	21.0	11.38	2.63	10.54	8.51	0.65	0.52
32	05.06.2023	1.0195	584	618	18.3	12.2	6.1	61.1	20.6	11.33	2.49	14.75	10.90	0.64	0.49
33	12.06.2023	1.0275	590	629	18.2	13.6	4.6	63.2	18.6	11.27	2.60	12.35	11.05	0.58	0.47
34	19.06.2023	1.0302	589	625	18.1	13.9	4.2	63.9	18.0	11.24	2.40	12.89	11.14	0.56	0.47
35	26.06.2023	1.0269	591	632	21.0	13.2	7.8	60.2	18.7	11.28	2.20	12.24	10.29	0.66	0.47
36	03.07.2023	1.014	615	706	20.7	11.4	9.3	57.2	22.1	11.53	2.9	0.00	0.00	0.75	0.50
37	10.07.2023	1.0064	612	702	20.7	11.4	9.3	54.9	24.4	11.61	2.8	0.00	0.00	0.82	0.56
38	17.07.2023	1.0098	608	688	18.6	9.1	9.5	58.1	23.4	11.55	2.8	0.00	0.00	0.72	0.48
39	24.07.2023	1.0064	612	702	17.3	11.0	6.3	58.3	24.4	11.61	2.8	0.00	0.00	0.71	0.55
	min	0.9596	511	482.0	12.5	8.0	2.5	41.7	18.0	11.2	1.8	0.0	0.0	0.56	0.47
	max	1.0302	623	721.5	21.0	17.2	9.5	63.9	44.2	11.7	2.9	17.7	16.6	1.40	1.09

Note: The meaning of designations used in Table S4 is following:

Feed D15 = density of H-Oil feed, g/cm<sup>3</sup>;

Feed T50 = boiling point of 50% of evaporate according to the HTSD (ASTM D7169 of H-Oil feed, °C;

Feed MW = Molecular weight of H-Oil feed, g/mol;

Feed C5 asp. = Content of C<sub>5</sub> asphaltenes in H-Oil feed, wt.%;

Feed C7 asp. = Content of C<sub>7</sub> asphaltenes in H-Oil feed, wt.%;

Feed Res = Content of resins in H-Oil feed, wt.%;

Feed ARO = Content of aromatic compounds in H-Oil feed, wt.%;

Feed Sat = Content of saturated compounds in H-Oil feed, wt.%;

Feed Kw = Kw-characterization factor of H-Oil feed;

Feed Sulphur = Content of sulphur in H-Oil feed;

Recycle wt.% of feed = Content of recycle from partially blended fuel oil in H-Oil feed, wt.% of total feed;

FCC SLO in Feed = Content of fluid catalytic cracking slurry oil in H-Oil feed, wt.% of total feed;

Feed CII (C5) = Colloidal instability index of H-Oil feed determined on the base of C<sub>5</sub> asphaltene content;

Feed CII (C7) = Colloidal instability index of H-Oil feed determined on the base of C<sub>7</sub> asphaltene content;

The colloidal instability index is calculated by the expression:

$$CII = \frac{\text{Saturates} + \text{Asphaltenes}}{\text{Aromatics} + \text{Resins}}$$



**Table S5.** High temperature simulated distillation (HTSD) data of H-Oil feed

HTSD of H-Oil feed	11.04.2022	23.05.2022	30.05.2022	06.06.2022	13.06.2022	20.06.2022	27.06.2022	04.07.2022	11.07.2022	05.09.2022	03.10.2022	28.11.2022	03.01.2023
wt. %	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
IBP 0.5	380	404	369	339	367	266	270	293	274	183	173	217	221
1	400	412	381	358	381	281	283	308	286	200	194	242	246
2	422	425	397	380	396	304	308	328	309	220	214	267	271
3	437	435	408	394	407	323	328	344	329	243	231	286	290
4	448	443	418	405	416	338	346	356	346	261	243	305	309
5	463	452	429	414	425	350	359	366	359	296	255	320	326
6	472	465	436	423	433	359	370	374	371	340	265	332	341
7	480	473	443	431	439	367	381	383	382	364	275	345	353
8	489	480	451	437	444	376	391	391	391	380	286	355	368
9	497	488	462	443	450	384	398	397	398	393	295	367	381
10	503	497	471	449	460	392	406	403	405	406	306	376	393
11	508	502	477	459	468	398	413	409	411	417	314	385	406
12	514	508	484	467	474	404	421	415	418	427	324	394	418
13	519	513	492	473	479	410	428	421	424	437	330	404	430
14	524	519	498	479	485	416	434	427	430	447	338	414	441
15	529	524	504	485	491	422	439	432	435	455	346	423	451
16	533	528	508	491	497	428	445	437	440	464	353	432	461
17	537	532	514	497	501	434	450	441	444	472	359	441	470
18	540	536	519	502	506	438	460	445	448	480	366	451	479
19	544	540	523	506	510	443	468	450	456	487	371	459	487
20	547	543	527	510	514	447	473	458	464	494	377	468	494
21	551	546	531	515	519	454	479	466	469	500	382	477	500
22	554	550	535	519	523	462	485	470	474	505	387	485	506
23	557	553	539	523	527	468	491	475	478	511	392	492	511
24	560	556	542	527	530	473	497	479	483	515	398	498	516

25	563	559	545	531	534	478	502	485	489	520	403	504	520
26	565	562	549	534	537	483	506	490	495	524	409	510	525
27	568	565	552	538	541	489	511	496	499	529	414	515	529
28	570	567	556	541	544	495	516	500	504	533	419	519	533
29	573	570	559	544	547	499	520	504	508	536	425	524	536
30	575	572	561	548	550	504	525	508	512	540	431	528	540
31	578	575	564	551	553	508	529	513	516	543	437	532	543
32	580	577	567	554	557	512	532	517	521	547	444	536	547
33	583	580	570	557	559	517	536	521	525	550	450	540	550
34	585	582	572	560	562	521	540	525	528	554	457	543	554
35	587	584	575	563	565	525	543	529	532	557	464	547	557
36	590	587	577	565	568	529	547	533	536	560	471	550	560
37	592	589	580	568	570	533	550	537	539	563	479	553	563
38	594	592	583	571	573	537	554	540	543	566	486	557	566
39	597	594	585	573	575	541	557	544	546	568	493	560	568
40	599	596	588	576	578	544	560	547	550	571	499	563	571
41	601	598	590	578	581	548	563	551	553	574	505	565	573
42	604	601	593	581	583	551	566	554	557	576	511	568	576
43	606	603	595	584	586	555	569	557	560	579	516	571	579
44	609	606	598	586	588	558	572	561	563	582	521	574	581
45	611	608	600	589	591	561	575	564	566	584	527	576	584
46	613	610	603	591	593	565	577	567	569	587	531	579	587
47	616	613	605	594	596	568	580	570	572	590	536	582	589
48	618	615	608	596	598	571	583	573	575	592	540	584	592
49	620	617	610	599	601	574	586	576	578	595	545	587	594
50	623	619	613	602	603	577	589	579	581	597	549	590	597
51	625	622	615	604	606	580	591	582	584	600	553	592	599
52	627	624	618	607	609	583	594	585	587	602	557	595	602
53	630	626	620	610	611	586	597	587	590	605	561	597	604

54	632	629	623	612	614	589	600	590	593	607	565	600	607
55	634	631	625	615	616	592	603	593	595	610	568	602	609
56	636	633	628	618	619	595	606	596	598	612	571	605	612
57	638	635	630	620	621	598	609	599	601	615	575	608	614
58	640	637	632	623	624	601	611	602	604	617	578	610	617
59	643	640	635	626	627	604	614	605	607	620	582	613	619
60	645	642	637	628	629	607	617	608	610	622	585	615	622
61	647	644	639	631	632	610	620	611	613	625	589	618	624
62	649	646	642	633	634	613	623	614	616	627	592	620	627
63	651	648	644	636	636	616	626	617	619	629	595	623	629
64	653	650	647	638	639	619	629	620	622	632	599	626	631
65	655	653	649	641	641	622	631	623	626	634	602	628	634
66	657	654	651	643	644	625	634	626	629	636	605	631	636
67	659	656	654	646	646	628	637	629	631	638	609	633	638
68	662	658	656	648	649	631	640	632	634	641	612	635	641
69	664	661	658	651	651	634	642	635	637	643	615	638	643
70	666	663	660	653	653	637	645	638	640	645	619	640	645
71	669	666	663	655	655	640	648	641	643	648	622	643	648
72	671	668	666	657	658	643	651	644	646	650	625	645	650
73	673	671	668	660	660	646	653	647	649	652	629	648	652
74	675	673	671	662	663	649	656	650	652	655	632	650	654
75	678	675	673	665	666	652	659	653	655	657	635	653	656
76	681	678	676	668	668	655	662	656	657	659	638	655	659
77	683	680	679	670	671	657	665	659	660	662	641	657	662
78	685	683	681	673	673	661	668	662	664	665	644	660	664
79	688	685	684	675	676	664	671	665	667	668	648	663	667
80	690	688	687	678	679	667	674	669	670	671	651	667	670
81	693	691	690	681	682	671	678	672	673	674	654	670	673
82	695	693	692	684	685	674	681	676	677	677	657	673	676

83	698	695	695	686	688	677	684	680	681	681	660	676	680
84	701	699	698	689	691	681	689	683	684	684	664	680	683
85	703	702	701	692	694	684	691	687	688	687	669	683	686
86	706	704	704	695	697	688	694	691	691	691	673	687	689
87	709	707	707	698	701	692	698	694	695	694	677	691	693
88	712	710	710	702	704	695	702	698	699	697	682	694	695
89	716	714	714	705	707	699	706	702	703	701	686	697	699
<b>90</b>	<b>719</b>	<b>717</b>	<b>717</b>	<b>709</b>	<b>711</b>	<b>703</b>	<b>710</b>	<b>706</b>	<b>707</b>		<b>691</b>	<b>701</b>	<b>702</b>
91	730	723	724	713	715	707	714	711	711		695		706
92	744	738	739		719	712	718		716		700		709
93	758	753	754		733	717	732		723		704		713
94	773	769	770		751	729					709		717
95	789	786	787								714		722
96	809	806	808								720		731
97	835	833	835								730		746
98	872		873								742		
99	929		930										
FBP 99,5	972		971										
%Recovery	106.090	97.461	100.090	91.233	94.034	94.510	93.984	91.532	93.565	89.271	98.097	90.368	97.315
Content of material boiling below 360°C	-	-	-	2.11	-	6.13	5.09	4.40	5.08	6.83	17.14	8.42	7.47
Content of material boiling below 540°C	18.00	19.00	23.33	26.75	38.75	34.00	38.00	37.25	30.00	48.00	33.00	30.00	26.67
Content of material boiling above 540°C	82.00	81.00	76.67	73.25	61.25	66.00	62.00	62.75	70.00	52.00	67.00	70.00	73.33

T50% - 540 + Percentage	59.00	59.50	61.67	63.38	69.38	67.00	69.00	68.63	65.00	74.00	66.50	65.00	63.33
T50% - 540 + Degree	643.0	641.0	641.0	636.8	651.8	628.0	642.0	633.9	626.0	655.0	607.0	628.0	629.7

**Continuation of  
Table S5**

HTSD of H-Oil feed	30.01.2023	06.02.2023	13.02.2023	20.02.2023	27.02.2023	06.03.2023	13.03.2023	20.03.2023	27.03.2023	03.04.2023	10.04.2023	18.04.2023	24.04.2023
wt. %	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
IBP 0.5	273	177	241	233	270	235	219	225	206	216	196	181	253
1	294	202	260	253	282	256	246	246	225	236	208	202	287
2	326	237	282	278	303	280	269	270	247	250	229	236	321
3	347	253	298	297	318	296	283	290	264	266	243	261	337
4	364	269	313	313	331	310	295	309	281	282	256	287	348
5	379	282	325	327	341	322	307	323	298	297	268	310	357
6	392	296	335	337	351	331	316	334	314	313	280	326	364
7	406	307	343	347	359	339	325	343	328	326	292	338	371
8	418	319	352	356	368	348	332	352	339	338	306	347	376
9	430	327	359	365	375	355	339	360	351	349	317	355	381
<b>10</b>	<b>441</b>	<b>336</b>	<b>368</b>	<b>373</b>	<b>382</b>	<b>362</b>	<b>347</b>	<b>369</b>	<b>362</b>	<b>360</b>	<b>329</b>	<b>362</b>	<b>385</b>
11	452	345	374	380	389	369	354	375	373	372	338	368	389
12	461	351	380	388	396	375	359	383	384	384	349	373	393
13	470	360	387	395	403	381	367	389	395	395	357	378	397
14	479	367	393	402	410	387	373	397	406	407	368	382	401
15	486	374	399	410	417	393	378	404	417	419	377	386	405
16	493	381	406	417	424	399	385	412	426	430	386	390	408
17	499	387	412	424	430	406	390	419	436	440	396	395	412

18	504	393	419	431	437	412	397	426	445	451	407	398	415
19	509	401	425	439	444	418	404	433	453	459	416	402	417
20	514	407	431	446	450	424	410	441	461	468	425	406	420
21	519	414	437	453	457	430	417	448	469	476	434	410	423
22	523	421	444	460	464	436	423	455	476	483	443	413	426
23	527	427	450	467	470	443	429	462	483	490	451	416	429
24	531	434	457	475	477	449	435	469	489	496	459	419	431
25	534	441	463	482	484	455	442	476	494	501	466	423	434
26	538	449	470	488	490	462	448	483	499	506	474	426	437
27	541	456	477	494	496	469	454	489	504	511	481	429	440
28	544	463	484	500	501	476	461	494	508	515	488	432	443
29	547	471	490	506	507	482	467	500	513	519	494	435	446
30	550	478	496	511	512	488	473	505	517	523	500	439	449
31	554	485	502	516	516	494	479	509	521	527	505	442	452
32	557	492	508	521	521	500	485	514	524	531	510	446	455
33	559	498	513	525	525	506	490	518	528	534	515	449	458
34	562	504	518	530	530	511	496	522	532	538	519	453	461
35	565	510	523	534	534	516	501	526	535	541	523	456	464
36	567	515	528	538	538	520	505	530	538	544	528	460	468
37	570	520	533	541	541	525	510	534	542	547	532	463	471
38	572	525	537	545	545	529	514	538	545	550	535	467	474
39	575	529	541	548	548	534	519	541	548	553	539	471	477
40	577	534	544	552	552	537	523	545	551	556	542	474	481
41	580	538	548	555	555	541	527	548	554	559	546	478	484
42	582	541	552	558	558	545	531	552	557	562	549	482	487
43	585	545	556	562	562	549	535	555	560	565	552	485	490
44	587	549	559	565	565	552	538	558	563	568	556	489	493
45	589	553	562	567	568	556	542	562	566	570	559	492	496
46	592	556	565	570	570	559	545	565	569	573	562	496	500

47	594	559	568	573	573	562	549	568	571	576	565	500	503
48	596	563	571	576	576	566	553	571	574	578	568	504	506
49	599	566	574	579	579	569	556	574	577	581	570	507	510
50	601	569	577	581	581	572	559	577	579	584	573	511	513
51	603	572	580	584	584	574	563	580	582	586	576	515	517
52	606	575	583	587	587	577	566	583	585	589	579	519	520
53	608	578	586	590	590	580	569	586	588	592	582	522	524
54	610	581	589	593	592	583	572	589	591	594	584	526	527
55	613	584	592	595	595	586	575	592	593	597	587	530	531
56	615	587	595	598	598	589	578	595	596	600	590	534	535
57	617	590	597	601	601	592	581	597	599	602	593	538	539
58	620	593	600	604	603	595	584	600	602	605	596	542	542
59	622	596	603	607	606	598	587	603	604	608	599	546	546
60	624	599	606	610	609	601	591	607	607	611	602	550	550
61	626	602	609	612	612	604	594	609	610	613	605	554	554
62	629	605	612	615	614	607	597	612	613	616	608	558	558
63	631	608	615	618	617	610	600	615	616	619	610	562	562
64	633	611	618	621	620	613	603	618	619	622	613	566	566
65	635	614	621	624	623	616	606	621	622	625	616	570	569
66	637	617	624	627	626	619	609	624	624	627	619	574	573
67	639	620	627	630	628	622	613	627	627	630	622	578	577
68	641	623	630	632	631	625	616	630	630	633	625	582	581
69	643	626	633	635	634	628	619	633	633	635	628	586	585
70	645	629	635	638	636	630	622	635	635	638	631	591	589
71	647	632	638	640	639	633	625	638	638	640	634	595	593
72	649	635	641	643	642	636	628	641	641	643	637	599	597
73	651	637	644	646	644	639	631	643	644	646	639	603	601
74	653	640	647	649	647	642	634	646	646	649	642	608	606
75	655	643	649	652	649	644	637	649	649	651	645	612	610

76	657	646	652	654	652	647	640	651	652	654	648	616	614
77	659	649	655	657	654	650	643	654	654	656	651	621	618
78	662	652	657	659	657	653	646	656	657	659	654	625	623
79	664	654	660	663	660	655	649	659	660	662	656	629	627
80	667	660	663	666	663	658	652	662	663	665	659	633	631
81	670	663	667	669	666	661	655	665	666	668	663	638	635
82	672	667	670	672	669	664	657	669	670	672	666	642	640
83	675	670	673	676	672	668	661	672	673	674	670	646	644
84	678	673	676	679	675	671	664	675	676	678	673	650	648
85	681	677	680	683	679	674	668	678	680	682	677	654	652
86	685	682		687		678	672	682	684	685	681	658	656
87	688	685		691		682	675	686	687	689	685	663	661
88	691	690				686		690	691	693	689	668	666
89	694	693						693	695	696	693	673	671
90	698	697						697	699	700	697	678	676
91	701	702							703	704	701	684	682
92	705	706							707	708	705	690	688
93	709	710							711		709	695	694
94	713	715									714		700
95	717	721									719		706
96		731									738		713
97		732									762		
98		752											
99		790											
FBP 99,5		818											
%Recovery	95.995	101.290	85.196	87.039	85.477	88.620	87.480	90.729	93.375	92.523	97.433	93.061	96.616

Boiling below 360°C	3.76	13.00	9.11	8.44	7.11	9.71	12.13	9.00	9.82	10.00	13.27	9.71	5.43
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Boiling below 540°C	41.67	38.75	36.67	36.67	40.75	44.50	38.67	36.50	34.67	39.33	38.67	57.50	57.50
Boiling above 540°C	58.33	61.25	63.33	63.33	59.25	55.50	61.33	63.50	65.33	60.67	61.33	42.50	42.50
T50% - 540 + Percentage	70.83	69.38	68.33	68.33	70.38	72.25	69.33	68.25	67.33	69.67	69.33	78.75	78.75
T50% - 540 + Degree	646.7	627.1	631.0	633.0	637.1	636.8	620.0	630.8	628.0	637.0	629.0	628.0	626.0

**Continuation of  
Table S5**

HTSD of H-Oil feed	28.04.2023	09.05.2023	15.05.2023	22.05.2023	29.05.2023	05.06.2023	12.06.2023	19.06.2023	26.06.2023	03.07.2023	10.07.2023	17.07.2023	24.07.2023
wt. %	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
IBP 0.5	240	179	214	237	227	185	234	234	243	255	271	270	265
1	271	195	229	253	242	201	246	247	258	277	284	285	287
2	312	211	247	272	260	219	260	264	274	310	307	311	328
3	332	225	261	284	272	235	272	276	285	341	330	335	363
4	345	238	273	296	283	247	283	287	298	363	351	357	397
5	355	247	283	309	294	257	296	300	311	386	372	379	421
6	363	258	294	319	305	267	309	313	322	405	399	402	438
7	370	268	305	329	316	276	321	324	332	422	423	424	448
8	376	276	316	338	324	285	332	335	342	436	440	439	466
9	382	284	325	347	335	295	342	344	349	445	453	449	475
10	386	292	335	357	343	306	352	354	357	460	469	467	482
11	391	301	343	366	352	316	363	364	365	472	478	475	492
12	396	310	352	376	361	326	374	374	374	479	487	482	499

13	400	318	361	386	370	337	384	384	386	489	496	492	504
14	404	325	370	397	380	346	396	395	396	498	501	499	508
15	408	333	379	408	390	356	408	406	405	503	506	503	513
16	412	339	389	419	401	367	419	417	415	509	511	508	518
17	415	345	400	430	412	379	430	427	426	515	517	513	523
18	418	352	410	439	422	390	439	436	435	521	522	518	527
19	421	358	421	449	432	403	448	445	442	525	526	523	530
20	424	364	432	463	442	415	461	456	448	530	530	527	534
21	428	371	442	473	451	427	471	467	462	533	533	530	537
22	430	377	453	482	465	437	479	475	471	537	537	533	540
23	434	383	467	491	474	447	488	483	478	541	540	537	544
24	437	390	478	499	483	460	496	491	486	545	544	540	547
25	440	397	488	505	492	471	502	498	496	549	547	544	550
26	444	404	498	512	500	480	508	504	501	552	550	547	553
27	447	411	505	517	506	489	514	509	507	555	553	550	556
28	450	418	513	523	513	497	519	515	513	558	556	553	559
29	454	425	519	528	518	504	524	520	519	561	559	556	561
30	457	432	525	532	524	511	529	525	524	564	562	559	564
31	460	438	530	536	529	517	533	529	528	567	565	561	567
32	464	444	535	540	533	522	537	533	532	570	567	564	569
33	467	452	540	544	537	527	540	537	537	572	570	567	571
34	471	461	544	548	541	532	544	540	541	575	572	569	574
35	475	469	548	551	545	536	547	544	544	577	575	572	576
36	478	476	552	555	548	540	551	547	548	580	577	574	579
37	482	483	556	558	552	544	554	551	552	583	580	576	581
38	485	491	559	561	556	548	557	554	556	585	582	579	583
39	489	498	562	564	559	551	560	557	559	588	585	581	586
40	492	504	566	567	562	555	563	560	562	590	587	584	588
41	496	509	569	570	565	558	566	563	565	593	590	586	591

42	499	515	571	573	568	561	569	566	568	595	592	589	593
43	503	521	574	575	571	564	571	569	571	598	595	591	595
44	506	526	577	578	573	567	574	572	574	600	597	594	598
45	510	530	580	581	576	570	577	575	577	602	600	596	600
46	514	535	583	584	579	573	579	577	580	605	602	598	602
47	517	539	586	587	582	576	582	580	583	607	604	601	605
48	521	543	589	589	585	578	585	583	585	610	607	603	607
49	525	547	592	592	587	581	587	586	588	612	609	606	609
50	529	552	594	595	590	584	590	589	591	615	612	608	612
51	533	556	597	597	593	587	593	591	594	617	614	611	614
52	536	559	600	600	596	590	595	594	597	620	617	613	617
53	540	563	602	603	598	593	598	597	599	622	619	615	619
54	544	567	605	605	601	595	601	600	602	624	622	618	621
55	548	570	608	608	604	598	604	602	605	627	624	620	624
56	552	573	611	611	607	601	606	605	608	629	627	623	626
57	556	577	613	613	609	604	609	608	611	631	629	625	629
58	559	580	616	616	612	607	612	611	614	634	631	628	631
59	563	584	619	619	615	609	614	614	617	636	633	630	633
60	567	588	622	622	618	612	617	617	620	638	636	632	635
61	571	591	624	624	620	615	620	619	623	641	638	635	637
62	574	595	627	627	623	618	623	622	626	643	640	637	640
63	578	598	630	629	626	621	626	625	629	645	643	639	642
64	582	601	632	632	629	624	628	628	631	648	645	642	644
65	586	605	635	634	631	627	631	631	634	650	647	644	647
66	590	609	637	637	634	629	634	633	637	652	650	647	649
67	594	612	640	640	637	632	636	636	640	654	652	649	651
68	597	616	643	642	639	635	639	639	643	656	654	651	653
69	601	619	645	645	642	638	642	641	645	658	656	653	655
70	605	623	648	647	645	640	644	644	648	661	658	655	657

[illegible]

FBP 99,5													
%Recovery	92.059	91.229	90.009	91.846	90.756	89.337	91.290	92.008	89.501	87.843	87.676	85.764	88.060

Boiling below 360°C	5.63	19.33	12.89	10.33	11.89	15.36	10.73	10.60	10.38	3.86	4.43	4.14	2.91
Boiling below 540°C	53.25	47.25	33.00	32.00	33.75	36.00	33.00	34.00	33.75	22.75	23.00	24.00	22.00
Boiling above 540°C	46.75	52.75	67.00	68.00	66.25	64.00	67.00	66.00	66.25	77.25	77.00	76.00	76.00
T50% - 540 + Percentage	76.63	73.63	66.50	66.00	66.88	68.00	66.50	67.00	66.88	61.38	61.50	62.00	61.00
T50% - 540 + Degree	631.9	634.9	638.5	637.0	636.6	635.0	635.0	636.0	639.6	641.8	639.0	637.0	637.0

The meaning of designations is following:

Boiling below 360°C = Content of material boiling below 360°C, wt.%

Boiling below 540°C = Content of material boiling below 540°C, wt.%

Boiling above 540°C = Content of material boiling above 540°C, wt.%

T50% - 540 + Percentage = Percentage of T50% of fraction boiling above 540°C in H-Oil feed distillation curve, wt.%

T50% - 540 + Degree = T50% of fraction boiling above 540°C, °C

**Table S6.** Properties of H-Oil VTB

	Date	VTB D15	VTB T50	VTB MW	VTB C5 asp	VTB C7 asp	VTB Res	VTB ARO	VTB Sat.	VTB Kw	VTB Sulphur	VTB CII (C5)	VTB CII (C7)
No		g/cm3	°C	g/mol	wt.%	wt.%	wt.%	wt.%	wt.%		wt.%		
1	11.04.2022	1.0182	604	672	26.2	18.6	7.7	52.8	21.0	11.44	1.30	0.89	0.65
2	23.05.2022	1.0193	601	663	18.3	16.0	2.3	61.0	20.7	11.41	1.03	0.64	0.58
3	30.05.2022	1.0137	606	680	20.6	15.6	5.1	57.1	22.2	11.50	0.91	0.75	0.61
4	06.06.2022	1.0003	598	666	20.5	14.8	5.7	53.2	26.4	11.61	0.93	0.88	0.70
5	13.06.2022	1.0012	603	679	18.6	15.4	3.2	55.4	26.1	11.63	0.92	0.81	0.71
6	20.06.2022	1.0078	598	661	19.4	14.5	4.8	56.7	24.0	11.53	0.95	0.76	0.63
7	27.06.2022	1.0159	601	665	19.9	16.1	3.8	58.5	21.6	11.45	1.04	0.71	0.60
8	04.07.2022	1.0255	603	665	19.1	13.3	5.8	61.8	19.1	11.35	1.07	0.62	0.48
9	11.07.2022	1.0290	602	660	20.8	16.7	4.1	61.0	18.2	11.31	1.05	0.64	0.54
10	05.09.2022	1.0469	598	640	32.2	27.6	4.6	53.3	14.5	11.10	1.23	0.88	0.73
11	03.10.2022	1.0213	600	659	25.7	17.96	7.7	54.1	20.2	11.38	1.12	0.85	0.62
12	28.11.2022	1.0580	597	631	31.9	22.7	9.2	55.6	12.5	10.98	1.09	0.80	0.54
13	03.01.2023	1.0443	598	641	27.9	20.1	7.8	57.2	15.0	11.12	1.20	0.75	0.54
14	30.01.2023	1.041	595	635	30.0	21.2	8.8	54.3	15.6	11.15	1.09	0.84	0.58
15	06.02.2023	1.0342	594	636	25.8	18.4	7.3	57.2	17.1	11.22	0.82	0.75	0.55
16	13.02.2023	1.0395	600	649	25.9	17.3	8.7	58.1	15.9	11.18	0.79	0.72	0.50
17	20.02.2023	1.041	592	627	25.8	18.7	7.1	58.6	15.6	11.13	0.84	0.71	0.52
18	27.02.2023	1.034	588	620	22.2	17.9	4.3	60.8	17.0	11.19	0.78	0.64	0.54
19	06.03.2023	1.0390	591	626	24.8	18.6	6.2	59.2	16.0	11.15	0.78	0.69	0.53
20	13.03.2023	1.0411	591	625	27.4	22.6	4.8	57.1	15.6	11.13	0.67	0.75	0.62
21	20.03.2023	1.0364	583	607	26.8	18.9	7.9	56.6	16.6	11.14	0.89	0.77	0.55
22	27.03.2023	1.0572	585	602	28.6	24.2	4.4	58.8	12.6	10.93	0.87	0.70	0.58
23	03.04.2023	1.082	584	588	32.0	27.5	4.6	58.9	9.1	10.68	0.83	0.70	0.58
24	10.04.2023	1.0781	585	592	31.6	26.3	5.3	58.8	9.6	10.72	0.78	0.70	0.56
25	18.04.2023	1.0588	596	628	30.6	21.7	8.9	57.1	12.4	10.96	0.90	0.75	0.52

26	24.04.2023	1.0468	600	645	32.0	25.2	6.8	53.5	14.5	11.11	0.82	0.87	0.66
27	28.04.2023	1.0541	595	628	31.9	23.5	8.5	54.9	13.2	11.01	1.13	0.82	0.58
28	09.05.2023	1.0721	590	607	36.3	29.4	6.9	53.3	10.4	10.80	1.14	0.87	0.66
29	15.05.2023	1.0733	586	596	35.8	31.9	3.9	54.0	10.2	10.77	1.19	0.85	0.73
30	22.05.2023	1.0858	588	595	37.6	28.0	9.5	53.8	8.6	10.66	1.19	0.86	0.58
31	29.05.2023	1.0746	582	586	34.1	28.3	5.8	55.8	10.0	10.74	1.17	0.79	0.62
32	05.06.2023	1.0734	582	587	36.5	28.2	8.3	53.3	10.2	10.76	1.16	0.88	0.62
33	12.06.2023	1.0833	580	578	39.0	33.6	5.5	52.0	8.9	10.65	1.15	0.92	0.74
34	19.06.2023	1.0759	570	558	32.1	25.6	6.5	58.1	9.9	10.68	1.02	0.72	0.55
35	26.06.2023	1.0652	568	558	29.7	24.0	5.7	59.0	11.4	10.78	0.87	0.70	0.55
36	03.07.2023	1.0039	591	645	24.0	16.9	7.1	50.8	25.2	11.54	1.4	0.97	0.73
37	10.07.2023	1.0009	609	696	21.9	13.7	8.2	52.0	26.2	11.66	1.3	0.92	0.66
38	17.07.2023	1.0016	606	687	19.0	13.0	6.0	55.1	25.9	11.63	1.2	0.82	0.64
39	24.07.2023	0.9936	601	678	17.5	11.5	6.0	53.8	28.7	11.71	1.1	0.86	0.67
	min	0.9936	568	558	17.5	11.5	2.3	50.8	8.6	10.7	0.7	0.35	0.38
	max	1.0858	609	696	39.0	33.6	9.5	61.8	28.7	11.7	1.4	2.10	0.87

Note: The meaning of designations used in Table S6 is following:

VTB D15 = density of H-Oil VTB feed, g/cm<sup>3</sup>;

VTB T50 = boiling point of 50% of evaporate according to the HTSD (ASTM D7169 of H-Oil VTB, °C);

VTB MW = Molecular weight of H-Oil VTB, g/mol;

VTB C5 asp. = Content of C<sub>5</sub> asphaltenes in H-Oil VTB, wt.%;

VTB C7 asp. = Content of C<sub>7</sub> asphaltenes in H-Oil VTB, wt.%;

VTB Res = Content of resins in H-Oil VTB, wt.%;

VTB ARO = Content of aromatic compounds in H-Oil VTB, wt.%;

VTB Sat = Content of saturated compounds in H-Oil VTB, wt.%;

VTB Kw = Kw-characterization factor of H-Oil VTB;

VTB Sulphur = Content of sulphur in H-Oil VTB;

VTB CII (C5) = Colloidal instability index of H-Oil VTB determined on the base of C<sub>5</sub> asphaltene content;

VTB CII (C7) = Colloidal instability index of H-Oil VTB determined on the base of C<sub>7</sub> asphaltene content.



**Table S7.** High temperature simulated distillation data of H-Oil VTB

HTSD of H-Oil VTB	11.04.2022	23.05.2022	30.05.2022	06.06.2022	13.06.2022	20.06.2022	27.06.2022	04.07.2022	11.07.2022	05.09.2022	03.10.2022	28.11.2022	03.01.2023
wt. %	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
IBP 0.5	457	369	435	417	409	414	430	473	471	407	349	246	423
1	467	393	443	427	420	424	440	480	477	427	377	311	437
2	477	415	460	440	435	438	459	491	489	451	413	416	455
3	485	431	473	451	446	447	474	499	497	465	441	452	467
4	494	442	482	467	460	461	485	504	503	477	461	470	478
5	500	453	493	476	472	472	496	508	507	486	476	482	486
6	504	468	501	484	480	480	502	513	512	494	487	491	493
7	509	477	506	493	489	488	507	517	516	500	495	499	499
8	513	486	512	500	497	496	512	521	520	505	502	504	505
9	517	496	517	505	502	502	516	524	523	510	508	510	509
10	521	502	521	509	507	506	521	527	527	514	513	514	514
11	525	508	525	514	512	511	524	530	530	518	517	518	518
12	528	514	529	518	516	516	527	533	532	522	522	522	521
13	531	519	532	522	520	520	531	536	535	525	525	525	525
14	534	523	535	525	524	524	533	538	537	528	529	529	528
15	536	527	538	528	527	527	536	540	540	531	532	532	531
16	539	531	541	531	531	530	539	543	542	534	535	535	534
17	541	534	544	534	534	533	541	545	544	537	538	537	537
18	544	537	546	537	536	536	543	547	547	539	541	540	540
19	546	540	549	539	539	538	546	549	549	542	543	542	542
20	548	542	551	542	542	541	548	551	551	544	546	544	545
21	550	545	553	544	544	543	550	554	553	546	548	547	547
22	553	548	556	546	547	546	552	556	555	549	550	549	549
23	555	550	558	549	549	548	555	557	557	551	553	551	551
24	557	553	560	551	551	550	557	559	559	553	555	553	554

25	559	555	562	553	554	553	559	561	561	555	557	555	556
26	561	557	564	555	556	555	560	563	562	557	559	557	558
27	563	559	566	557	558	557	562	565	564	559	561	559	560
28	565	561	567	559	560	559	564	566	566	561	563	561	562
29	566	563	569	561	562	561	566	568	568	563	565	563	564
30	568	565	571	563	564	563	568	570	569	565	566	565	565
31	570	567	573	565	566	565	569	571	571	566	568	566	567
32	572	569	574	567	568	567	571	573	572	568	570	568	569
33	573	571	576	568	569	568	573	574	574	570	571	570	570
34	575	573	578	570	571	570	574	576	576	571	573	571	572
35	577	574	580	572	573	572	576	578	577	573	575	573	574
36	579	576	581	573	575	573	578	579	579	575	576	574	575
37	580	578	583	575	576	575	579	581	581	576	578	576	577
38	582	580	585	577	578	577	581	583	582	578	580	578	579
39	584	581	587	579	580	579	583	584	584	580	581	579	580
40	586	583	588	580	582	580	584	586	586	581	583	581	582
41	587	585	590	582	584	582	586	588	587	583	585	583	584
42	589	587	592	584	585	584	588	589	589	585	586	584	585
43	591	588	593	586	587	586	589	591	590	587	588	586	587
44	593	590	595	587	589	587	591	593	592	588	590	588	589
45	594	592	597	589	591	589	593	594	594	590	591	589	590
46	596	594	599	591	592	591	594	596	595	592	593	591	592
47	598	595	600	593	594	593	596	597	597	593	595	593	593
48	600	597	602	595	596	594	598	599	599	595	596	594	595
49	602	599	604	596	598	596	599	601	600	597	598	596	597
50	604	601	606	598	600	598	601	603	602	598	600	597	598
51	606	603	608	600	601	600	603	605	604	600	601	599	600
52	608	605	610	602	603	601	605	606	606	602	603	601	602
53	610	607	611	604	605	603	607	608	608	604	605	602	603

54	612	609	613	606	607	605	609	610	610	606	607	604	605
55	614	610	615	608	609	607	610	612	611	607	608	606	607
56	616	612	617	610	611	609	612	614	613	609	610	608	609
57	618	614	619	612	613	611	614	616	615	611	612	610	611
58	620	616	621	614	615	613	616	617	617	613	614	611	612
59	622	618	623	616	617	615	618	619	619	615	616	613	614
60	624	620	625	618	619	617	620	622	621	617	618	615	616
61	626	623	627	620	621	619	622	624	623	619	620	617	618
62	629	625	629	622	624	621	624	626	625	621	622	619	620
63	631	627	631	624	626	624	626	628	627	623	624	621	622
64	633	629	633	626	628	626	629	630	629	625	626	623	624
65	635	631	636	629	630	628	631	632	631	627	628	625	626
66	637	633	638	631	632	630	633	634	633	629	630	627	628
67	640	635	640	633	635	632	635	636	636	631	631	629	630
68	642	638	643	635	637	635	637	638	638	633	634	631	632
69	645	640	645	638	639	637	639	641	640	635	636	633	634
70	<b>647</b>	<b>643</b>	<b>647</b>	<b>640</b>	<b>642</b>	<b>639</b>	<b>642</b>	<b>643</b>	<b>643</b>	<b>638</b>	<b>638</b>	<b>635</b>	<b>636</b>
71	650	645	650	643	644	642	644	645	645	640	640	638	639
72	652	648	652	645	647	644	647	648	648	642	642	640	641
73	655	650	655	648	650	647	649	650	650	645	645	642	643
74	657	653	657	651	652	650	652	653	653	647	647	645	645
75	660	655	660	653	655	652	654	655	655	649	649	647	648
76	663	657	663	656	657	622	657	658	657	652	652	649	650
77	667	660	666	658	660	657	660	661	660	654	654	652	653
78	670	664	669	662	663	661	663	664	664	656	656	654	655
79	673	667	672	665	667	664	666	667	667	659	659	657	657
80	676	670	675	668	670	668	670	670	670	662	662	659	660
81	680	673	678	672	673	671	673	673	673	665	665	663	663
82	683	677	682	675	677	674	676	677	677	669	668	666	666

83	686	680	685	679	680	678	680	681	681	672	671	669	669
84	690	684	688	682	684	682	684	684	684	675	674	672	672
85	693	687	692	686	687	685	687	688	688	679	678	675	675
86	696	691	695	690	691	689	691	691	692	683	682	680	679
87	700	694	699	693	694	693	694	694	695	686	685	683	683
88	703	698	702	697	698	697	698	698	699	690	689	687	687
89	707	702	706	701	702	701	702	702	703	693	693	691	691
<b>90</b>	<b>711</b>	<b>706</b>	<b>710</b>	<b>705</b>	<b>706</b>	<b>705</b>	<b>706</b>	<b>706</b>	<b>707</b>	<b>697</b>	<b>696</b>	<b>694</b>	<b>694</b>
91	716	710	714	709	710	709	710	711	711	701	701	699	698
92	720	715	719	714	715	714	715	715	716		704	703	702
93	739	720	734		720	719	720	720	723		709	707	706
94	758	740	754		739	738	740	740			713		711
95	778	761	774		760	759					718		716
96	800	784	796		782						726		
97	829	812	825								736		
98	870	852	866										
99	932	915	928										
FBP 99,5	975	961	973										
%Recovery	105.380	101.030	101.190	92.425	96.412	95.481	94.301	94.884	93.401	91.248	97.329	93.431	95.830
Boiling below 360°C	-	-	-	-	-	-	-	-	-	-	0.70	1.47	-
Boiling below 540°C	16.50	19.00	15.67	19.33	19.33	19.67	16.50	15.00	15.00	18.33	17.67	18.00	18.00
Boiling above 540°C	83.50	81.00	84.33	80.67	80.67	80.33	83.50	85.00	85.00	81.67	82.33	82.00	82.00
T50% - 540 + Percentage	58.25	59.50	57.83	59.67	59.67	59.83	58.25	57.50	57.50	59.17	58.83	59.00	59.00
T50% - 540 + Degree	620.5	619.0	620.7	617.3	618.3	616.7	616.5	616.5	616.0	615.3	615.7	613.0	614.0

Continuation  
of Table S7

HTSD of H- Oil VTB	30.01.2023	06.02.2023	13.02.2023	20.02.2023	27.02.2023	06.03.2023	13.03.2023	20.03.2023	27.03.2023	03.04.2023	10.04.2023	18.04.2023	24.04.2023
wt. %	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
IBP 0.5	368	334	404	405	406	401	405	370	388	385	384	380	393
1	391	355	419	420	420	416	419	384	402	398	397	392	405
2	422	382	438	438	437	433	436	402	421	417	417	408	420
3	443	402	451	451	450	447	448	415	434	430	430	420	432
4	458	419	461	461	459	457	457	426	444	441	442	429	443
5	471	433	471	470	467	466	465	435	453	450	451	439	453
6	482	446	480	478	475	475	473	443	461	458	459	448	462
7	490	458	488	486	482	482	480	451	469	466	467	456	471
8	497	470	495	492	488	489	486	458	476	473	475	464	479
9	503	480	502	498	494	495	492	464	483	480	482	472	487
<b>10</b>	<b>508</b>	<b>489</b>	<b>507</b>	<b>503</b>	<b>499</b>	<b>500</b>	<b>497</b>	<b>471</b>	<b>488</b>	<b>486</b>	<b>487</b>	<b>480</b>	<b>494</b>
11	513	497	513	508	504	505	502	478	494	491	493	487	501
12	517	504	517	512	508	510	507	484	499	496	498	493	507
13	521	510	522	516	512	514	511	489	503	501	502	499	512
14	524	515	526	520	515	518	515	494	507	505	507	505	518
15	528	519	530	524	519	521	519	499	511	509	511	510	522
16	531	524	534	527	522	525	522	503	515	513	514	515	527
17	534	528	537	530	525	528	525	508	518	516	518	520	531
18	537	531	540	533	528	531	529	512	522	519	521	524	535
19	539	535	543	536	531	534	532	515	525	522	524	528	538
20	542	538	545	538	533	537	535	519	528	525	527	532	541

21	544	540	548	541	536	539	537	522	530	528	530	536	544
22	546	543	550	543	538	541	540	525	533	531	532	539	547
23	549	545	553	545	540	544	542	528	536	534	535	542	550
24	551	548	555	548	543	546	544	531	538	536	537	545	553
25	553	550	557	550	545	548	546	534	540	538	540	548	555
26	555	553	560	552	547	550	549	536	542	541	542	550	558
27	557	555	562	554	549	552	551	539	545	543	544	553	560
28	559	557	564	556	551	554	553	541	547	545	546	556	562
29	561	559	566	558	553	556	555	543	549	547	548	558	564
30	563	561	567	560	555	558	557	545	551	549	550	560	566
31	564	563	569	561	557	560	559	548	553	551	552	562	568
32	566	565	571	563	558	562	561	550	555	553	554	564	570
33	568	567	573	565	560	564	563	552	557	555	556	566	572
34	569	568	574	567	562	565	564	554	558	557	558	568	574
35	571	570	576	568	563	567	566	556	560	559	560	570	575
36	573	572	577	570	565	569	568	558	562	560	561	572	577
37	574	573	579	571	567	570	569	560	564	562	563	574	579
38	576	575	581	573	568	572	571	562	566	564	565	576	580
39	577	576	582	575	570	573	573	564	567	566	567	577	582
40	579	578	584	576	572	575	574	565	569	567	568	579	584
41	581	580	586	578	573	576	576	567	571	569	570	581	585
42	582	581	587	579	575	578	577	569	572	571	572	583	587
43	584	583	589	581	576	580	579	571	574	572	573	584	589
44	586	585	591	583	578	581	581	572	575	574	575	586	590
45	587	586	592	584	580	583	582	574	577	576	577	588	592
46	589	588	594	586	581	585	584	576	579	577	578	590	594
47	591	590	595	587	583	586	586	578	580	579	580	591	595
48	592	591	597	589	584	588	587	579	582	581	582	593	597
49	594	593	599	591	586	589	589	581	584	582	583	595	598

<b>50</b>	<b>595</b>	<b>594</b>	<b>600</b>	<b>592</b>	<b>588</b>	<b>591</b>	<b>591</b>	<b>583</b>	<b>585</b>	<b>584</b>	<b>585</b>	<b>596</b>	<b>600</b>
51	597	596	602	594	589	593	592	585	587	586	587	598	602
52	599	598	604	596	591	594	594	587	589	588	588	600	603
53	600	599	605	597	593	596	596	589	591	589	590	602	605
54	602	601	607	599	595	598	597	590	592	591	592	603	607
55	604	603	609	601	596	600	599	592	594	593	594	605	609
56	606	604	610	602	598	601	601	594	596	595	596	607	610
57	608	606	612	604	600	603	603	596	598	597	598	609	612
58	609	608	614	606	602	605	604	598	600	598	599	611	614
59	611	610	616	608	604	607	606	600	601	600	601	612	615
60	613	612	618	610	605	609	608	602	603	602	603	614	617
61	615	613	620	612	607	611	610	604	605	604	605	616	619
62	617	615	622	614	609	612	612	606	607	606	607	618	621
63	619	617	623	616	611	614	614	608	609	608	609	620	623
64	621	619	625	618	613	616	616	610	611	610	611	622	625
65	623	621	627	620	615	619	618	612	613	612	613	624	627
66	625	623	629	622	618	621	620	615	615	614	615	626	629
67	627	625	631	624	620	623	622	617	618	617	618	628	631
68	629	627	633	626	622	625	625	619	620	619	620	630	632
69	631	630	635	628	624	627	627	622	622	621	622	632	634
<b>70</b>	<b>633</b>	<b>632</b>	<b>638</b>	<b>631</b>	<b>626</b>	<b>629</b>	<b>629</b>	<b>624</b>	<b>624</b>	<b>624</b>	<b>625</b>	<b>634</b>	<b>637</b>
71	636	634	640	633	629	632	631	626	627	626	627	637	639
72	638	636	642	635	631	634	633	629	629	628	629	639	641
73	640	638	645	637	633	636	636	631	631	631	632	641	643
74	642	641	647	640	636	639	638	634	634	633	634	644	646
75	645	643	649	643	638	641	641	636	636	635	637	646	648
76	647	646	652	645	641	644	644	639	639	638	640	649	651
77	650	648	654	648	644	647	646	642	642	641	642	651	653
78	652	651	656	651	647	649	649	645	645	644	645	654	655

79	655	653	659	653	649	652	652	648	647	647	649	656	657
80	657	656	662	656	652	654	654	651	650	650	651	659	660
81	660	658	666	659	655	657	657	654	653	653	654	662	664
82	663	661	669	662	658	660	660	657	656	656	657	666	667
83	666	665	672	666	661	664	664	660	659	659	661	669	671
84	670	668	675	670	665	668	668	664	663	663	665	673	674
85	673	672	679	673	669	672	672	669	667	667	669	676	677
86	676	675	683	677	673	675	675	672	671	671	673	680	681
87	680	679	687	682	677	679	679	676	675	675	677	684	685
88	684	683	691	686	682	684	684	681	679	680	682	688	689
89	688	687	694	690	686	688	688	685	684	684	686	692	692
90	692	691	698	694	690	692	692	690	688	689	691	695	696
91	695	695		698	694	696	696	694	693	694	695	700	701
92	700	699		703	700	701	701	699	698	699	700	704	704
93	704	704			704	706	706		703	703	705	708	709
94	708	708					712		708	709	711	714	714
95	714	714					717		714	715	717	719	719
96	719	720					734		721	725	731	738	740
97	729	731							749	754	760	767	768
98		754								797	804	808	810
99		794								864	873	872	876
FBP 99,5		823									924	919	924
%Recovery	97.628	104.270	90.475	92.147	93.855	93.933	96.625	92.948	97.560	99.416	101.660	99.985	101.650

Boiling below 360°C	-	1.19	-	-	-	-	-	-	-	-	-	-	-
Boiling below 540°C	19.33	21.00	18.00	20.67	23.00	21.50	22.00	27.50	25.00	25.67	25.00	22.33	19.67



Boiling above 540°C	80.67	79.00	82.00	79.33	77.00	78.50	78.00	72.50	75.00	74.33	75.00	77.67	80.33
T50% - 540 + Percentage	59.67	60.50	59.00	60.33	61.50	60.75	61.00	63.75	62.50	62.83	62.50	61.17	59.83
T50% - 540 + Degree	612.3	612.5	616.0	610.7	608.0	610.5	610.0	609.5	608.0	607.7	608.0	616.3	616.7

Continuation  
of Table S7

HTSD of H- Oil VTB	28.04.2023	09.05.2023	15.05.2023	22.05.2023	29.05.2023	05.06.2023	12.06.2023	19.06.2023	26.06.2023	03.07.2023	10.07.2023	17.07.2023	24.07.2023
wt. %	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C
IBP 0.5	405	362	326	396	396	388	391	382	367	397	432	434	415
1	416	377	360	408	407	399	402	393	381	409	441	442	431
2	431	398	389	423	421	415	417	409	399	429	459	461	444
3	442	413	407	435	432	426	428	421	410	439	473	473	460
4	452	425	421	443	439	435	437	431	422	446	483	482	472
5	460	435	432	452	446	443	444	438	432	458	494	492	480
6	468	444	441	462	453	450	451	445	438	469	501	499	489
7	475	454	449	470	461	459	460	451	443	474	506	505	497
8	482	464	460	476	468	467	467	459	447	480	511	509	502
9	488	473	468	482	473	473	473	466	455	486	517	515	506
10	494	480	475	489	478	478	478	471	464	493	522	520	511
11	499	488	482	495	483	484	483	475	468	498	526	524	516
12	504	494	489	499	488	489	489	479	472	502	530	527	521
13	509	500	495	504	493	494	494	484	476	505	533	531	524
14	513	505	500	508	498	499	498	488	479	509	536	534	527

15	517	510	504	512	502	503	502	492	483	513	539	537	530
16	521	514	508	516	505	506	506	496	488	517	542	540	533
17	525	519	513	519	509	510	509	499	493	520	545	542	536
18	528	522	517	523	512	513	513	502	497	523	548	545	539
19	532	526	520	526	516	517	516	505	499	526	550	548	541
20	535	529	524	529	519	520	519	507	502	529	553	550	544
21	538	532	527	531	522	523	522	510	504	531	555	552	546
22	541	535	530	534	525	526	525	513	507	534	557	555	549
23	543	537	532	536	528	528	528	516	509	536	560	557	551
24	546	540	535	539	530	531	530	518	512	539	562	559	553
25	548	542	537	541	533	533	532	521	515	541	564	561	556
26	551	545	540	543	535	536	535	523	518	543	566	563	558
27	553	547	542	545	537	538	537	525	521	546	568	565	560
28	555	549	544	548	540	540	539	527	523	548	569	567	562
29	558	552	547	550	542	542	541	530	525	550	571	569	564
30	560	554	549	552	544	544	543	532	527	552	573	570	566
31	562	556	551	554	546	546	545	534	529	555	575	572	567
32	564	558	553	556	548	549	548	536	531	557	576	574	569
33	565	560	555	558	551	551	550	538	533	559	578	576	571
34	567	562	557	560	553	553	552	540	536	561	580	577	573
35	569	564	559	561	555	555	554	542	538	563	582	579	574
36	571	565	561	563	557	557	556	544	540	565	584	581	576
37	573	567	563	565	559	559	558	546	542	567	585	583	578
38	574	569	565	567	560	560	559	548	544	568	587	584	580
39	576	571	567	569	562	562	561	550	546	570	589	586	581
40	578	572	568	570	564	564	563	552	548	572	591	588	583
41	579	574	570	572	566	566	565	554	550	574	592	590	585
42	581	576	572	574	568	567	567	556	552	576	594	591	587
43	583	578	574	575	569	569	568	557	554	578	596	593	588

44	585	579	575	577	571	571	570	559	556	580	598	595	590
45	586	581	577	579	573	573	572	561	558	581	599	597	592
46	588	583	579	581	575	574	573	563	560	583	601	598	594
47	590	585	581	582	576	576	575	565	562	585	603	600	595
48	591	587	583	584	578	578	577	567	564	587	605	602	597
49	593	588	585	586	580	580	579	568	566	589	607	604	599
50	595	590	586	588	582	582	580	570	568	591	609	606	601
51	597	592	588	590	584	583	582	572	570	593	611	608	603
52	598	594	590	591	586	585	584	574	572	595	612	609	605
53	600	595	592	593	588	587	586	576	573	597	614	611	607
54	602	597	594	595	589	589	588	578	575	599	616	613	609
55	604	599	596	597	591	591	590	580	577	601	618	615	611
56	606	601	597	599	593	593	592	582	579	603	620	617	612
57	607	603	599	600	595	595	593	584	581	605	622	619	614
58	609	605	601	602	597	597	595	586	584	607	624	621	617
59	611	607	603	605	599	598	597	588	586	610	626	623	619
60	613	609	606	607	601	600	599	590	588	612	629	625	621
61	615	611	608	609	603	603	601	592	590	614	631	627	623
62	617	613	610	611	605	605	604	594	592	616	633	630	625
63	619	615	612	613	607	607	606	596	594	619	635	632	627
64	621	617	614	615	610	609	608	599	597	621	637	634	630
65	623	619	616	617	612	611	610	601	599	623	639	636	632
66	625	621	618	619	614	613	612	603	601	626	641	638	634
67	627	624	621	621	616	616	614	606	604	628	644	640	636
68	629	626	623	624	618	618	617	608	606	631	646	643	638
69	631	628	625	626	621	620	619	611	609	633	648	645	641
70	633	631	628	628	623	623	621	613	611	636	651	647	643
71	636	633	630	631	626	625	624	616	614	638	653	650	646
72	638	636	633	633	628	628	627	619	617	641	655	652	649

73	640	638	635	636	631	631	629	621	620	644	658	655	651
74	643	641	638	638	633	633	632	624	623	647	661	657	654
75	645	643	640	641	636	636	634	627	626	649	664	660	656
76	648	646	643	644	639	638	637	630	629	652	667	663	659
77	651	649	646	646	642	641	640	633	632	655	670	666	662
78	653	652	649	649	645	644	643	636	635	658	673	669	666
79	655	655	652	652	648	647	646	640	638	661	675	672	669
80	658	657	655	655	651	651	649	643	642	665	679	675	672
81	661	661	658	658	654	654	652	647	645	669	682	678	675
82	665	665	662	662	657	657	655	650	649	672	685	682	679
83	668	669	666	666	661	661	659	654	653	676	688	685	683
84	672	672	670	670	665	665	663	657	656	680	691	688	686
85	675	676	674	673	669	669	667	662	661	684	694	691	690
86	679	681	678	678	673	673	671	667	666	687	697	694	693
87	683	685	683	682	678	678	675	672	671	691	701	698	696
88	687	690	687	686	683	683	680	676	675	694	704	701	700
89	691	694	692	691	687	687	685	682	681	699	708	705	704
90	694	698	695	695	692	692	690	687			712	709	708
91	699	703	701	700	696	696		692					713
92	703	707	705	704				698					
93	708	713						703					
94	713	719						709					
95	718												
96	736												
97	764												
98	806												
99	872												
FBP 99,5	921												
%Recovery	100.310	94.516	92.656	92.056	91.776	91.945	90.199	94.176	89.762	89.182	90.170	90.699	91.368

Boiling below 360°C	-	-		-	-	-	-	-	-	-	-	-	
Boiling below 540°C	21.67	24.00	26.00	24.50	28.00	28.00	28.50	34.00	36.00	24.50	15.33	16.00	18.33
Boiling above 540°C	78.33	76.00	74.00	75.50	72.00	72.00	71.50	66.00	64.00	75.50	84.67	84.00	81.67
T50% - 540 + Percentage	60.83	62.00	63.00	62.25	64.00	64.00	64.25	67.00	68.00	62.25	57.67	58.00	59.17
T50% - 540 + Degree	614.7	613.0	612.0	611.5	610.0	609.0	608.5	606.0	606.0	616.8	623.3	621.0	619.5

**Table S8.** Content of metals in H-Oil feed and VTB

**H-**

**Oil**

**Feed**

**H-Oil**

**VTB**

Date	V, mg/kg	Ni, mg/kg	Na, mg/kg	Fe, mg/kg	Al, mg/kg	Ca, mg/kg	V, mg/kg	Ni, mg/kg	Na, mg/kg	Fe, mg/kg	Al, mg/kg	Ca, mg/kg
11.04.2022	105.1	20.8					165.2	40.9				
23.05.2022	196	30.2	12.3	32.2	32.2	4.2	140	40	18.7	95.7	64.7	19.3
30.05.2022	151	29.3	7.5	27.2	25.3	2.5	106	40.5	8.3	94	49.7	6.9
06.06.2022	122	27.2	6.5	22	11.5	1.5	73	27.9	6.6	75.8	44	4.5
13.06.2022	134	39.1	8.2	24.3	10	1.2	75	38.3	7.9	73.5	37.6	4
20.06.2022	118	36	4.2	22.6	21.2	1.1	53	29.7	1.8	51.3	34.8	3
27.06.2022	129	31.9	2.1	25.5	24.9	0.9	70	35.9	1.1	73.8	41.9	3.1
04.07.2022	124	35.5	4.7	25	21.9	0.8	66	36.7	1	82.5	44.1	2.9
11.07.2022	126	36	2.7	25.3	22.2	0.85	66	36.4	1	81.9	43.7	2.9
05.09.2022	179	45.7	8.6	38.2	12.6	2.1	122.3	50.1	1	148.9	51.8	6.6
03.10.2022	113	30.2	8.4	29.6	12.9	1.5	91	45.9	2.9	12.5	95.1	4.6
28.11.2022	181	33.4	9.2	34.4	18.2	2.8	21.1	10.8	2.4	27.5	10.6	1.7

03.01.2023	139.6	38.3	6.4	45.5	20.3	4.4	87.8	59.9	4.4	151.5	72.1	6.4
30.01.2023	165.8	48.3	19.5	59.9	16.5	2.2	99	78.4	8.4	159.3	56.6	5.1
06.02.2023	147.7	40.9	3.6	41	24	3.1	57	48.6	2.3	100.7	65	5.9
13.02.2023	140.2	32.3	3.3	33.1	14	2.8	42.4	30.3	0.95	71.5	54.4	5.9
20.02.2023	145.2	37.4	3.7	34.5	26	4.7	43.3	34.1	1.4	66.1	39.6	5.2
27.02.2023	159.5	42.8	5.2	43.3	14.7	2	59.4	38.9	3.3	101.1	57.1	4.7
06.03.2023	152.1	39.2	6.7	54.7	12.9	2	57.1	34.1	3.2	111.7	49.4	4.3
13.03.2023	122.5	34.1	5.5	46.8	19.7	1.6	57.6	33.5	2.1	137.7	86.4	5.3
20.03.2023	151	42.6	9.1	40.7	21.6	2.3	93.4	53.7	7.4	173	139	6.6
27.03.2023	165.9	34.1	12.1	47.6	21.7	2.9	73.5	44.7	11.2	126.4	88.6	5.3
03.04.2023	182.1	47.8	14	61.4	22.3	6.5	61.4	46.5	7.5	109.4	80.9	9.5
10.04.2023	136.4	38.1	11.1	42.6	53	2.6	79.9	50.7	8.2	138	171.9	5.8
18.04.2023	102.5	34.8	7.3	30	9.3	7.5	74.6	48.8	6.2	124.5	66.2	15.6
24.04.2023	102	29.7	3.5	34	7	12.4	136.9	49.3	2.3	202	78.3	14.9
28.04.2023	137	31.8	6	33.6	6.9	2.6	165.2	48.8	3.9	218.8	70.6	11.3
09.05.2023	150	38.7	7.2	46	21.4	5.2	109.4	51.6	6.9	203.4	84	7
15.05.2023	189.4	53.5	12.2	49.2	18.1	1.8	106.1	58	2.3	149	67.9	4.8
22.05.2023	190.6	43.4	11.3	45.5	15.2	4	119.9	58.6	0.095	144.8	70.6	6
29.05.2023	170.6	46.6	9.4	35.5	17.6	1.5	98.3	65.4	7.7	136.1	61.7	4.7
05.06.2023	151.5	48.9	5.9	41.6	19.2	1.6	176.3	71.7	6.3	239.4	141.2	6.3
12.06.2023	146.5	49.7	7.2	53.6	18.5	1.7	147.1	82.8	3.6	187.5	88.3	5.8
19.06.2023	133	36.6	6.8	34.1	17.3	2.4	82.2	49.5	10	99.4	57.9	3.8
26.06.2023	148.5	32.1	1.7	40.8	17	2.3	93.8	53.4	3.8	113.7	63.4	5.5
03.07.2023	210.4	48.4	9.6	48.8	14.5	1.9	251.5	81	3.7	282	100.5	7.4
10.07.2023	226	45.4	12.7	50.9	12.4	1.7	218	48.9	7.3	206.1	54.4	5.5
17.07.2023	203	46.7	4.3	57.1	13.3	2.3	152.5	65.2	< 1,0	202.5	46	4.7
17.07.2023 (after filtration of VTБ by removing sediments in the HFT apparatus)							26	33.7	< 1,0	21.6	2.1	2.5
24.07.2023	201.2	45.4	12.8	60	12.2	2.4	131.1	51.7	9	163.6	39	4.7

**Table S9.** H-Oil product yields obtained during the study of the 40 cases

No	Date	Gas, wt. %	Naphtha, wt. %	Diesel, wt. %	VGO, wt. %	VTB, wt. %	H <sub>2</sub> S, wt. %	Total, wt. %	Balance conversion (100-(VTB+H <sub>2</sub> S)), wt. %
1	11.04.2022	5.7	4.7	26.7	25.0	37.0	2.9	102.0	60.1
2	23.05.2022	5.8	5.6	32.5	29.7	25.9	2.7	102.1	71.4
3	30.05.2022	5.5	4.5	30.1	32.1	27.5	2.3	101.9	70.2
4	06.06.2022	5.4	5.1	28.3	34.4	26.6	2.1	101.9	71.2
5	13.06.2022	5.1	4.3	27.6	35.4	27.5	2.1	101.9	70.5
6	20.06.2022	5.7	5.6	31.6	35.4	21.8	1.9	102.0	76.3
7	27.06.2022	5.8	5.4	33.5	35.8	19.6	2.0	102.0	78.4
8	04.07.2022	6.0	6.2	33.9	36.9	17.1	2.0	102.0	81.0
9	11.07.2022	6.1	6.2	34.0	37.0	16.7	2.0	102.0	81.4
10	05.09.2022	6.8	6.1	34.6	32.4	19.3	2.8	102.1	77.8
11	03.10.2022	5.6	5.9	37.0	40.6	10.6	2.1	101.9	87.2
12	28.11.2022	6.9	6.7	36.5	35.9	14.1	2.1	102.3	83.7
13	03.01.2023	6.5	6.5	30.0	34.7	21.9	2.6	102.2	75.5
14	30.01.2023	6.3	7.1	30.8	34.2	21.3	2.5	102.3	76.2
15	06.02.2023	6.7	6.2	36.1	36.4	15.1	2.1	102.5	82.8
16	13.02.2023	6.8	6.0	32.8	41.8	13.2	2.0	102.5	84.8
17	20.02.2023	7.1	6.5	34.8	37.9	14.3	2.1	102.7	83.6
18	27.02.2023	7.1	6.5	35.1	38.4	13.6	2.0	102.7	84.3
19	06.03.2023	6.8	6.1	34.0	42.1	11.7	2.0	102.6	86.3
20	13.03.2023	7.1	6.1	36.1	42.4	9.2	2.0	102.9	88.8
21	20.03.2023	5.9	6.4	35.3	40.7	12.4	1.9	102.6	85.7
22	27.03.2023	7.0	6.6	40.5	35.0	11.7	2.3	103.0	86.1
23	03.04.2023	8.0	7.2	41.6	36.1	7.3	2.3	102.4	90.4
24	10.04.2023	8.5	6.7	41.5	36.7	7.7	1.9	103.1	90.4
25	18.04.2023	6.5	7.3	36.0	44.2	6.2	2.1	102.3	91.7

26	24.04.2023	6.6	7.3	37.3	43.4	5.6	2.2	102.4	92.2
27	28.04.2023	7.1	7.4	39.1	38.8	7.8	2.5	102.6	89.8
28	09.05.2023	8.0	7.8	45.5	29.9	9.3	2.7	103.1	88.0
29	15.05.2023	8.5	7.7	42.4	29.1	12.5	2.8	103.1	84.7
30	22.05.2023	7.7	7.5	41.8	30.4	12.9	2.8	103.1	84.3
31	29.05.2023	7.5	7.5	42.0	30.1	13.4	2.5	103.0	84.0
32	05.06.2023	6.3	7.3	44.4	30.2	12.4	2.6	103.2	85.0
33	12.06.2023	7.7	7.3	44.1	27.7	13.7	2.6	103.1	83.7
34	19.06.2023	7.5	8.1	44.1	27.0	13.9	2.6	103.1	83.5
35	26.06.2023	8.2	7.7	41.5	26.6	16.8	2.2	103.0	80.9
36	03.07.2023	4.3	2.4	20.1	25.2	47.3	2.9	102.2	49.8
37	10.07.2023	3.5	2.2	20.9	31.1	41.6	3.0	102.2	55.4
38	17.07.2023	3.5	2.1	19.3	31.3	43.0	2.9	102.2	54.0
39	24.07.2023	3.7	2.2	20.5	26.8	46.1	2.9	102.2	51.0
40	11.08.2023	4.1	2.3	19.5	32.0	41.5	2.9	102.2	55.6
	min	3.5	2.1	19.3	25.0	5.6	1.9	101.9	49.8
	max	8.5	8.1	45.5	44.2	47.3	3.0	103.2	92.2



**Table S10.**  $\mu$ -value of the ICrA evaluation of relations of HDAs, HDM, conversion, reactor temperatures, ATB TSE, PBFO TSP, product yields, and H-Oil VTB properties.

$\mu$	HDAs (C <sub>5</sub> )	HDAs (C <sub>7</sub> )	H-Oil conv.	HDM	T-R1001	T- R1002	ATB TSE	PBFO, TSP	VT B D15	VT B T50	VT B M W	VT B C <sub>5</sub> asp	VT B C <sub>7</sub> asp	VT B Sat.	VTB Sul.,
HDAs(C <sub>5</sub> )	1.00	<b>0.88</b>	<b>0.79</b>	<b>0.83</b>	0.46	0.48	0.48	0.46	0.64	0.38	0.36	0.58	0.62	0.35	<b>0.26</b>
HDAs(C <sub>7</sub> )	<b>0.88</b>	1.00	<b>0.78</b>	<b>0.83</b>	0.47	0.50	0.51	0.47	0.65	0.40	0.37	0.57	0.59	0.35	<b>0.27</b>
H-Oil conv.	<b>0.79</b>	<b>0.78</b>	1.00	<b>0.82</b>	0.57	0.55	0.36	0.40	0.82	0.24	0.20	0.76	0.79	0.17	0.36
HDM	<b>0.83</b>	<b>0.83</b>	<b>0.82</b>	1.00	0.53	0.53	0.40	0.41	0.68	0.33	0.30	0.61	0.63	0.31	0.26
T-R1001	0.46	0.47	0.57	0.53	1.00	0.90	0.17	0.19	0.56	0.07	<b>0.03</b>	0.53	0.53	<b>0.03</b>	0.20
T-R1002	0.48	0.50	0.55	0.53	<b>0.90</b>	1.00	0.22	0.23	0.56	0.15	<b>0.11</b>	0.54	0.55	<b>0.09</b>	0.26
ATB TSE	0.48	0.51	0.36	0.40	<b>0.17</b>	<b>0.22</b>	1.00	0.65	0.34	0.69	0.70	0.33	0.35	0.62	0.45
PBFO, TSP	0.46	0.47	0.40	0.41	<b>0.19</b>	<b>0.23</b>	0.65	1.00	0.35	0.63	0.65	0.36	0.36	0.62	0.52
VTB D15	0.64	0.65	<b>0.82</b>	0.68	0.56	0.56	0.34	0.35	1.00	0.20	0.14	0.87	0.89	0.00	0.47
VTB T50	0.38	0.40	0.24	0.33	<b>0.07</b>	<b>0.15</b>	0.69	0.63	0.20	1.00	<b>0.91</b>	0.25	0.21	<b>0.76</b>	0.55
VTB MW	0.36	0.37	0.20	0.30	<b>0.03</b>	<b>0.11</b>	0.70	0.65	0.14	<b>0.91</b>	1.00	0.20	0.16	<b>0.84</b>	0.56
VTB C <sub>5</sub> asp	0.58	0.57	<b>0.76</b>	0.61	0.53	0.54	0.33	0.36	<b>0.87</b>	<b>0.25</b>	<b>0.20</b>	1.00	0.92	0.13	0.53
VTB C <sub>7</sub> asp	0.62	0.59	<b>0.79</b>	0.63	0.53	0.55	0.35	0.36	<b>0.89</b>	<b>0.21</b>	<b>0.16</b>	<b>0.92</b>	1.00	0.11	0.50
VTB Sat.	0.35	0.35	0.17	0.31	<b>0.03</b>	<b>0.09</b>	0.62	0.62	0.00	<b>0.76</b>	<b>0.84</b>	0.13	0.11	1.00	0.51
VTB Sul., wt. %	<b>0.26</b>	0.27	0.36	0.26	<b>0.20</b>	0.26	0.45	0.52	0.47	0.55	0.56	0.53	0.50	0.51	1.00
Feed T50	<b>0.15</b>	<b>0.15</b>	0.21	<b>0.18</b>	0.13	0.16	0.51	0.51	0.37	0.57	0.61	0.39	0.39	0.61	0.68
Feed MW	<b>0.17</b>	<b>0.17</b>	0.20	<b>0.20</b>	0.11	0.14	0.54	0.54	0.34	0.61	0.65	0.37	0.37	0.65	0.69
Feed Sul., wt. %	0.31	0.30	0.38	0.28	0.19	0.26	0.43	0.52	0.48	0.53	0.53	0.54	0.52	0.50	<b>0.89</b>
Recycle	0.68	0.65	<b>0.78</b>	0.68	0.48	0.46	0.33	0.37	0.78	0.20	<b>0.19</b>	0.72	0.77	<b>0.21</b>	0.34
Gas yield, %	0.67	0.67	<b>0.81</b>	0.73	0.56	0.56	0.33	0.32	0.86	0.20	<b>0.15</b>	<b>0.77</b>	<b>0.82</b>	<b>0.13</b>	0.40
Naphtha yield, %	0.64	0.65	<b>0.80</b>	0.66	0.56	0.55	0.35	0.40	<b>0.87</b>	0.20	<b>0.15</b>	<b>0.82</b>	<b>0.84</b>	<b>0.12</b>	0.48
Diesel yield, %	0.70	0.69	<b>0.84</b>	0.70	0.54	0.56	0.29	0.38	<b>0.85</b>	0.20	<b>0.16</b>	<b>0.81</b>	<b>0.85</b>	<b>0.15</b>	0.44
VGO yield, %	<b>0.75</b>	<b>0.76</b>	0.65	<b>0.75</b>	0.41	0.44	0.55	0.51	0.51	0.52	0.50	0.47	0.46	0.48	0.27
VTB yield, %	<b>0.15</b>	0.16	<b>0.07</b>	<b>0.15</b>	<b>0.04</b>	<b>0.08</b>	0.56	0.54	0.24	0.67	0.73	0.28	0.26	<b>0.76</b>	0.65
VTB V, ppm	0.35	0.33	0.43	0.27	<b>0.20</b>	<b>0.23</b>	0.49	0.55	0.49	0.50	0.52	0.57	0.55	0.50	<b>0.74</b>
VTB Ni, ppm	0.39	0.40	0.52	0.38	0.34	0.35	0.36	0.48	0.63	0.36	0.37	0.67	0.67	0.37	0.66

Note: The bold values are those which denote the presence of statistically meaningful relation.

As input data, the ICrA method requires an  $m \times n$  table with the measurements or evaluations of  $m$  objects against  $n$  criteria. As a result, it returns an  $n \times n$  table with intuitionistic fuzzy pairs, defining the degrees of relation between each pair of criteria, hence the name “intercriteria”, and allows making informed decisions which render account of the inherent uncertainty that complex real-life problems exhibit. For the sake of terminological precision, in ICrA, the term “correlation” between the criteria is avoided but the terms “positive consonance”, “negative consonance” and “dissonance” are being used instead. For industrial objects which are characterized by a relatively strong “noise” caused by different disturbances of the process the meaning of  $\mu = 0.70 \div 1.00$ ;  $\nu = 0 \div 0.30$  denotes a statistically meaningful significant positive relation, where the strong positive consonance exhibits values of  $\mu = 0.90 \div 1.00$ ;  $\nu = 0 \div 0.1$ , and the weak positive consonance exhibits values of  $\mu = 0.70 \div 0.80$ ;  $\nu = 0.20 \div 0.30$ . Respectively, the values of negative consonance with  $\mu = 0 \div 0.30$ ;  $\nu = 0.70 \div 1.00$  means a statistically meaningful negative relation, where the strong negative consonance exhibits values of  $\mu = 0 \div 0.1$ ;  $\nu = 0.90 \div 1.00$ , and the weak

negative consonance exhibits values of  $\mu = 0.20 \div 0.30$ ;  $\nu = 0.70 \div 0.80$ . All other cases are considered as dissonance.

**Table S11.**  $\nu$ -value of the ICrA evaluation of relations of HDAs, HDM, conversion, reactor temperatures, ATB TSE, PBFO TSP, product yields, and H-Oil VTB properties.

$\nu$	HDAs (C <sub>5</sub> )	HDAs (C <sub>7</sub> )	H-Oil conv.	HDM	T- R1001	T- R1002	ATB TSE	PBFO, TSP	VTB D15	VTB T50	VTB MW	VTB C <sub>5</sub> asp	VTB C <sub>7</sub> asp	VTB Sat.	VTB Sul.
HDAs(C <sub>5</sub> )	0.00	0.11	0.19	0.16	0.12	0.16	0.48	0.51	0.36	0.59	0.63	0.41	0.38	0.64	0.73
HDAs(C <sub>7</sub> )	0.11	0.00	0.21	0.17	0.11	0.14	0.46	0.50	0.35	0.57	0.62	0.42	0.40	0.64	0.72
H-Oil conv.	0.19	0.21	0.00	0.17	0.01	0.10	0.60	0.57	0.18	0.72	0.79	0.23	0.21	0.82	0.62
HDM	0.16	0.17	0.17	0.00	0.05	0.12	0.56	0.56	0.31	0.64	0.68	0.38	0.36	0.68	0.73
T-R1001	0.12	0.11	0.01	0.05	0.00	0.04	0.40	0.40	0.03	0.51	0.55	0.06	0.05	0.56	0.39
T-R1002	0.16	0.14	0.10	0.12	0.04	0.00	0.41	0.42	0.09	0.48	0.53	0.11	0.10	0.56	0.39
ATB TSE	0.48	0.46	0.60	0.56	0.40	0.41	0.00	0.29	0.63	0.25	0.26	0.63	0.62	0.34	0.51
PBFO, TSP	0.51	0.50	0.57	0.56	0.40	0.42	0.29	0.00	0.62	0.32	0.32	0.60	0.61	0.35	0.44
VTB D15	0.36	0.35	0.18	0.31	0.03	0.09	0.63	0.62	0.00	0.77	0.85	0.13	0.11	0.99	0.52
VTB T50	0.59	0.57	0.72	0.64	0.51	0.48	0.25	0.32	0.77	0.00	0.05	0.72	0.76	0.20	0.41
VTB MW	0.63	0.62	0.79	0.68	0.55	0.53	0.26	0.32	0.85	0.05	0.00	0.79	0.83	0.14	0.43
VTB C <sub>5</sub> asp	0.41	0.42	0.23	0.38	0.06	0.11	0.63	0.60	0.13	0.72	0.79	0.00	0.07	0.86	0.45
VTB C <sub>7</sub> asp	0.38	0.40	0.21	0.36	0.05	0.10	0.62	0.61	0.11	0.76	0.83	0.07	0.00	0.88	0.49
VTB Sat.	0.64	0.64	0.82	0.68	0.56	0.56	0.34	0.35	0.99	0.20	0.14	0.86	0.88	0.00	0.47
VTB Sul., wt. %	0.73	0.72	0.62	0.73	0.39	0.39	0.51	0.44	0.52	0.41	0.43	0.45	0.49	0.47	0.00
Feed T50	0.82	0.82	0.76	0.79	0.45	0.48	0.44	0.44	0.61	0.38	0.36	0.58	0.59	0.36	0.29
Feed MW	0.82	0.82	0.79	0.79	0.48	0.50	0.42	0.43	0.65	0.36	0.34	0.62	0.63	0.34	0.30
Feed Sul., wt. %	0.67	0.69	0.60	0.70	0.39	0.38	0.52	0.43	0.50	0.43	0.44	0.44	0.47	0.48	0.08
Recycle	0.31	0.35	0.21	0.31	0.10	0.18	0.64	0.60	0.22	0.77	0.80	0.27	0.23	0.78	0.64
Gas yield , %	0.69	0.73	0.64	0.68	0.39	0.45	0.45	0.45	0.55	0.44	0.44	0.54	0.53	0.43	0.35
Naphtha yield, %	0.32	0.33	0.18	0.26	0.03	0.09	0.64	0.65	0.14	0.77	0.84	0.22	0.17	0.85	0.59
Diesel yield, %	0.35	0.34	0.19	0.33	0.03	0.10	0.61	0.56	0.13	0.77	0.84	0.17	0.16	0.87	0.51

VGO yield, %	0.29	0.31	0.15	0.30	0.04	0.09	0.67	0.59	0.15	0.77	0.83	0.18	0.14	0.84	0.55
VTB yield, %	0.25	0.23	0.34	0.24	0.18	0.21	0.42	0.46	0.49	0.45	0.49	0.52	0.54	0.51	0.71
VTB V, ppm	0.69	0.72	0.59	0.70	0.36	0.38	0.50	0.44	0.47	0.45	0.46	0.39	0.41	0.52	0.19
VTB Ni, ppm	0.64	0.67	0.56	0.72	0.38	0.41	0.48	0.42	0.51	0.47	0.47	0.42	0.44	0.49	0.24

**Table S12.** Operating conditions and calculated parameters from the heat balance of the FCC unit for the studied cases

No.	Date	FCC Feed Rate	HT VGO	HOILVGOs in FCC FEED	ROT	CFT	Air rate	Str. steam	Disp.+ lift steams	T REG dense	T REG dilute	Hydrogen in COKE	COKE	CTO	HEAT OF REACTION	Δ COKE	Coke of Spent- regenerated Catalyst
		t/h	t/h	%	°C	°C	Nm <sup>3</sup> /h	kg/h	kg/h	°C	°C	wt%	wt%	t/t	kJ/kg CF	wt%	
1	11.04.2022	194	194	18	550	325	114309	5126	10520	686	698	8.1	5	9.8	598	0.51	0.51
2	23.05.2022	252	175	31	550	316	136590	5335	10100	700	707	7.9	5	8.5	526	0.56	0.60
3	30.05.2022	251	176	30	550	320	135847	5335	9600	695	703	7.1	5	9.0	567	0.55	0.54
4	06.06.2022	251	176	30	550	320	137190	5335	9620	687	697	6.9	5	9.5	565	0.52	0.52
5	13.06.2022	245	174	29	545	321	134886	5223	9700	681	692	6.0	5	9.7	607	0.52	0.61
6	20.06.2022	250	172	31	545	318	137288	5223	9700	685	696	7.5	5	9.2	560	0.53	0.50
7	27.06.2022	250	175	30	550	318	136800	4943	9500	693	702	7.6	5	9.2	578	0.54	0.50
8	04.07.2022	250	175	30	550	317	135974	5443	9700	693	700	7.8	5	9.1	561	0.54	0.56
9	11.07.2022	249	165	34	550	314	135478	5518	9700	696	703	7.6	5	9.0	566	0.55	0.54
10	05.09.2022	250	172	31	550	307	136108	6922	9700	703	709	6.1	5	8.4	517	0.59	0.64
11	03.10.2022	250	202	21	544	320	139103	6814	9800	710	718	7.3	5	7.3	470	0.65	0.63
12	28.11.2022	250	203	19	550	314	137514	5030	9363	713	721	7.2	5	7.6	484	0.63	0.74
13	03.01.2023	251	207	20	550	320	136290	5232	9600	710	717	7.2	5	7.6	469	0.62	0.49
14	30.01.2023	252	194	23	550	316	137220	5232	10100	709	716	5.9	5	7.8	471	0.63	0.56
15	06.02.2023	213	183	30	550	314	123357	5915	10499	711	720	6.2	5	7.7	471	0.65	0.62
16	13.02.2023	211	179	29	550	312	124056	5915	12839	713	721	5.7	5	7.6	468	0.66	0.64
17	20.02.2023	203	181	23	550	316	113715	5915	10086	703	714	6.0	5	8.2	488	0.60	0.54

18	<b>27.02.2023</b>	189	171	20	550	314	111529	5732	10150	703	714	5.5	5	8.4	519	0.61	0.54
19	<b>06.03.2023</b>	201	176	21	550	314	119115	5676	10282	710	718	4.5	5	7.8	473	0.66	0.53
20	<b>13.03.2023</b>	184	168	37	547	314	106970	5832	10968	704	714	5.5	5	7.9	471	0.63	0.61
21	<b>20.03.2023</b>	158	143	41	545	301	106850	5587	11150	717	725	5.4	5	7.3	451	0.72	0.40
22	<b>27.03.2023</b>	151	140	24	547	302	99749	5232	11150	698	712	5.0	6	9.0	551	0.62	0.57
23	<b>03.04.2023</b>	148	137	19	547	317	93623	5032	13215	690	707	5.8	5	9.2	548	0.57	0.50
24	<b>10.04.2023</b>	151	127	36	547	303	92884	5401	14159	700	713	5.3	5	8.7	532	0.62	0.47
25	<b>09.05.2023</b>	202	166	46	542	299	117252	5897	10300	705	717	4.5	5	7.9	513	0.66	0.58
26	<b>22.05.2023</b>	191	170	24	545	306	114242	5867	10350	691	708	6.8	5	9.0	546	0.57	0.59
27	<b>29.05.2023</b>	191	170	33	545	305	112375	5867	10350	697	713	6.6	5	8.7	558	0.59	0.56
28	<b>05.06.2023</b>	171	157	30	545	298	104152	5867	10312	698	713	4.9	5	8.8	560	0.62	0.61
29	<b>19.06.2023</b>	198	170	31	545	299	119545	5867	10400	699	714	5.4	5	8.7	566	0.62	0.54
30	<b>26.06.2023</b>	213	183	24	545	304	122888	5867	9800	694	709	5.4	5	8.9	562	0.59	0.55
31	<b>03.07.2023</b>	217	189	17	545	311	124227	5867	10167	687	704	6.5	5	9.2	555	0.55	0.58
32	<b>10.07.2023</b>	216	190	17	545	311	124206	5867	9800	688	704	6.3	5	9.1	549	0.56	0.54
33	<b>17.07.2023</b>	218	190	20	546	311	126831	5867	9777	697	711	5.5	5	8.7	560	0.60	0.54
34	<b>24.07.2023</b>	216	193	18	546	312	127273	5867	9783	692	707	4.6	5	9.0	570	0.59	0.54
35	<b>11.08.2023</b>	230	199	21	546	323	129095	5867	9783	692	707	6.3	5	8.6	533	0.57	0.53

**Table S13.** Conversion and product yields obtained from the FCC unit for the studied cases

No.	Date	FCC Conv.	Dry gas	C3	C4	Naphtha	LCO	HCO	Slurry	Coke
		wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%	wt%
1	11.04.2022	78.80	5.81	8.46	13.80	45.68	6.87	9.47	4.86	5.02
2	23.05.2022	71.14	5.91	6.64	11.22	42.51	10.66	8.28	9.92	4.80
3	30.05.2022	72.88	5.68	7.19	11.93	43.14	11.34	7.53	8.25	4.93
4	06.06.2022	74.74	6.19	6.97	12.06	44.56	11.15	7.11	7.01	4.95
5	13.06.2022	74.78	5.99	6.70	12.46	44.52	11.21	7.44	6.57	5.05
6	20.06.2022	72.49	5.63	6.58	11.62	43.78	11.03	7.55	8.94	4.85
7	27.06.2022	73.55	6.67	6.68	11.75	43.43	11.19	7.95	7.32	4.94
8	04.07.2022	73.71	6.20	6.70	11.31	44.59	10.96	8.14	7.19	4.87
9	11.07.2022	73.45	6.32	6.59	11.10	44.46	11.17	8.18	7.20	4.93
10	05.09.2022	71.75	6.26	6.31	10.84	43.35	10.79	9.73	7.74	4.98
11	03.10.2022	74.76	5.47	7.07	11.73	45.69	9.37	8.89	6.99	4.72
12	28.11.2022	74.44	6.83	6.00	10.55	46.15	9.25	9.14	7.17	4.84
13	03.01.2023	74.47	6.34	6.22	10.69	46.45	9.14	9.91	6.48	4.72
14	30.01.2023	74.77	6.31	6.12	10.96	46.48	8.65	10.06	6.51	4.87
15	06.02.2023	72.84	6.71	6.02	11.02	44.11	8.53	10.27	8.36	4.95
16	13.02.2023	72.23	5.97	5.83	11.10	44.25	8.93	10.55	8.29	5.00
17	20.02.2023	73.98	5.79	6.48	12.22	44.51	9.31	10.79	5.91	4.95
18	27.02.2023	75.36	6.07	6.91	12.63	44.57	9.16	10.47	5.01	5.15
19	06.03.2023	73.60	6.22	6.60	12.15	43.48	10.21	11.26	4.93	5.12
20	13.03.2023	71.96	5.07	6.47	11.73	43.66	10.83	12.30	4.91	4.97
21	20.03.2023	70.72	4.97	7.09	11.69	41.66	8.65	10.03	10.60	5.28
22	27.03.2023	74.90	5.11	7.00	12.90	44.34	7.07	11.76	6.26	5.52
23	03.04.2023	75.68	4.92	7.21	13.26	44.98	6.56	12.40	5.36	5.29
24	10.04.2023	71.63	4.77	6.68	11.62	43.14	6.66	11.40	10.30	5.38
25	09.05.2023	72.74	4.76	6.45	10.74	45.51	8.28	9.78	9.21	5.22
26	22.05.2023	76.87	5.07	7.20	12.02	47.35	8.31	7.74	7.08	5.15
27	29.05.2023	75.54	5.58	7.13	11.73	45.84	8.03	7.70	8.73	5.18
28	05.06.2023	75.50	5.73	7.49	12.13	44.69	6.91	9.72	7.87	5.44
29	19.06.2023	72.98	5.08	7.42	11.69	43.41	8.60	10.50	7.92	5.34
30	26.06.2023	74.25	4.84	7.53	11.69	44.93	8.25	10.68	6.82	5.24
31	03.07.2023	75.96	4.97	7.75	12.37	45.79	9.27	10.11	4.67	5.07
32	10.07.2023	77.47	5.30	7.87	12.48	46.68	9.05	8.55	4.92	5.07
33	17.07.2023	75.25	5.06	7.60	12.16	45.14	9.55	8.19	7.01	5.20
34	24.07.2023	77.74	5.36	7.81	13.22	46.02	8.86	7.77	5.64	5.30
35	11.08.2023	76.59	5.01	7.39	12.47	46.70	8.87	9.79	4.75	4.93

**Table S14.**  $\mu$ -value of the ICRA evaluation of relations of H-Oil performance variables and FCC performance variables.

$\mu$	H-Oil conv	PBFO, TSP	FCC SLO, % in H-Oil Feed	Hoil VGO in FCC Feed, %	H-Oil VGO D15	Dry Gas, wt. %	PPF, wt. %	BBF, wt. %	CN, wt. %	LCO, wt. %	HCO, wt. %	SLO, wt. %
Conversion, %	0.48	0.59	<b>0.28</b>	<b>0.21</b>	0.49	0.47	0.64	0.66	0.79	0.37	0.45	0.26
H-Oil VGO in FCC Feed, %	0.54	0.42	0.71	1.00	0.46	0.36	0.41	0.31	0.26	0.50	0.41	0.73
H-Oil VGO D15	<b>0.71</b>	0.47	0.60	0.46	1.00	0.35	0.47	0.32	0.55	0.25	0.61	0.59
Coke, wt. %	<b>0.72</b>	0.29	0.51	0.51	0.53	0.20	0.57	0.55	0.38	0.22	0.58	0.45
$\Delta$ Coke	<b>0.74</b>	0.32	0.61	0.46	0.59	0.40	0.32	0.33	0.44	0.34	0.67	0.51
Dry Gas yield, wt. %	0.28	0.50	0.40	0.36	0.35	1.00	0.26	0.35	0.49	0.63	0.36	0.42
PPF yield, wt. %	0.50	0.54	0.41	0.41	0.47	0.26	1.00	0.71	0.49	0.39	0.42	0.43
BBF yield, wt. %	0.49	0.51	0.28	0.31	0.32	0.35	0.71	1.00	0.46	0.41	0.49	0.29
CN yield, wt. %	0.49	0.54	0.36	<b>0.26</b>	0.55	0.49	0.49	0.46	1.00	0.36	0.44	0.34
LCO yield, wt. %	<b>0.21</b>	0.58	0.43	0.50	0.25	0.63	0.39	0.41	0.36	1.00	0.29	0.46
HCO yield, wt. %	<b>0.75</b>	<b>0.24</b>	0.49	0.41	0.61	0.36	0.42	0.49	0.44	0.29	1.00	0.38
SLO yield, wt. %	0.50	0.52	<b>0.79</b>	<b>0.73</b>	0.59	0.42	0.43	0.29	0.34	0.46	0.38	1.00

Note: The bold values are those which denote the presence of statistically meaningful relation.

**Table S15.**  $\nu$ -value of the ICRA evaluation of relations of H-Oil performance variables and FCC performance variables.

$\nu$	H-Oil conv	PBFO, TSP	FCC SLO, % in H-Oil Feed	Hoil VGO in FCC Feed, %	H-Oil VGO D15	Dry Gas, wt.%	PPF, wt.%	BBF, wt.%	CN, wt.%	LCO, wt.%	HCO, wt.%	SLO, wt.%	
Conversion,%		0.51	0.38	0.71	0.72	0.48		0.47	0.31	0.29	0.18	0.59	0.54
H-Oil VGO in FCC Feed, %		0.39	0.48	0.22	0.00	0.45		0.55	0.48	0.58	0.66	0.41	0.51
H-Oil VGO D15		0.30	0.47	0.36	0.45	0.00		0.57	0.45	0.60	0.39	0.70	0.36
Coke, wt.%		0.18	0.56	0.36	0.35	0.32		0.64	0.25	0.28	0.47	0.65	0.28
$\Delta$ Coke		0.26	0.60	0.33	0.42	0.32		0.50	0.58	0.57	0.48	0.58	0.26
Dry Gas yield, wt.%		0.67	0.42	0.54	0.55	0.57		0.00	0.64	0.56	0.44	0.29	0.58
PPF yield, wt.%		0.45	0.39	0.53	0.48	0.45		0.64	0.00	0.21	0.43	0.53	0.52
BBF yield, wt.%		0.45	0.42	0.66	0.58	0.60		0.56	0.21	0.00	0.46	0.51	0.45
CN yield, wt.%		0.48	0.41	0.61	0.74	0.39		0.44	0.43	0.46	0.00	0.58	0.53
LCO yield, wt.%		0.75	0.36	0.53	0.41	0.70		0.29	0.53	0.51	0.58	0.00	0.67
HCO yield, wt.%		0.24	0.72	0.49	0.51	0.36		0.58	0.52	0.45	0.53	0.67	0.00
SLO yield, wt.%		0.48	0.43	0.19	0.18	0.36		0.51	0.49	0.64	0.62	0.49	0.59

#### Nomenclature:

AR	Atmospheric residue
ATB	Atmospheric tower bottom product
BBF	Butane-Butylene fraction
Basrah H	Basrah Heavy crude oil
CAS	Computer algebra system
CII	Colloidal instability index

CN	Cracked naphtha (gasoline)
CPC	Caspian pipeline consortium
CSTR	Continuous stirred tank reactor
D15	Density at 15°C, g/cm <sup>3</sup>
FCC	Fluid catalytic cracking
FCCPT	Fluid catalytic cracking pretreater (feed hydrotreater)
HAGO	Heavy atmospheric gas oil
HCO	Heavy cycle oil
HDAs	Hydrodeasphaltization
HDAs(C <sub>5</sub> ),	Extent of removal of C <sub>5</sub> -asphaltenes, %
HDAs(C <sub>7</sub> ),	Extent of removal of C <sub>7</sub> -asphaltenes, %
HDM	Hydrodemetallization
HDS	Hydrodesulfurization
HVGO	Heavy vacuum gas oil
IBP	Initial boiling point
ICrA	Intercriteria analysis
LCO	Light cycle oil
LHSV	Liquid hourly space velocity
LSCO	Light Siberian crude oil
LNB	LUKOIL Neftohim Burgas
LVGO	Light vacuum gas oil
MNA	Mono-nuclear aromatics
MW	Molecular weight
PBFO	Partially blended fuel oil
PPF	Propane-Propylene fraction
Sat.	Saturate content
SLO	Slurry oil
SRVGO	Straight run vacuum gas oil
SRVR	Straight run vacuum residue
Sul.	Sulphur content
T50	Temperature at 50% evaporate
T-R1001	Temperature in the first ebullated bed reactor
T-R1002	Temperature in the second ebullated bed reactor
TSE	Total sediment existent, wt. %
TSP	Total sediment potential, wt. %
TBP	True boiling point distillation
VDU	Vacuum distillation unit
VGO	Vacuum gas oil
VR	Vacuum residue
VTB	Vacuum tower bottom product = hydrocracked vacuum residue
WABT	Weight average bed temperature