

SUPPORTING INFORMATION FOR

**OPTIMIZATION APPROACHES FOR EFFICIENT CRUDE BLENDING IN LARGE
OIL REFINERIES**

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I. VALIDATING THE TWO-STEP SEQUENTIAL APPROACH

I.1 Data for Examples 1-3

Table S1. Problem data for Examples 1-3

Tank	Crude oil Stored	Amount (m ³)	Sulfur concentration (ppm)	Emptying due date (day)	
				Ex. 1	Ex. 2-3
tk ₁	cr ₁	15,000	1518	15	18
tk ₂	cr ₂	20,000	1087	20	18
tk ₃	cr ₃	30,000	848	20	22
tk ₄	cr ₄	20,000	794	20	18
tk ₅	cr ₅	10,000	2040	10	22
tk ₆	cr ₆	30,000	552	20	22
tk ₇	cr ₁	20,000	1518	20	18
tk ₈	cr ₅	30,000	2040	20	22
tk ₉	cr ₂	30,000	1087	20	18
tk ₁₀	cr ₆	30,000	552	20	22
tk ₁₁	cr ₄	20,000	794	20	22
tk ₁₂	cr ₃	20,000	848	20	18
tk ₁₃	cr ₁	15,000	1518	15	22
tk ₁₄	cr ₃	30,000	848	20	22
tk ₁₅	cr ₄	20,000	794	20	22
tk ₁₆	cr ₅	20,000	2040	20	22
tk ₁₇	cr ₂	50,000	1087	-	22
tk ₁₈	cr ₁	10,000	1518	-	22
tk ₁₉	cr ₆	20,000	552	-	22
tk ₂₀	cr ₄	40,000	794	-	22

Additional data:

Tank unloading flow rate (min-max): 100-400 (m³/h)

Feed flow rate to the CDU : 500 (m³/h)

Maximum sulfur concentration in the feedstock: 1800 ppm

Table S2. Microcut yields of the available crude oils for Examples 1-3

Boiling range (°C)	Normalized weight	Yield of each microcut in the available crude oils (%)						Desired microcut yield (%)		
		cr ₁	cr ₂	cr ₃	cr ₄	cr ₅	cr ₆	Ex. 1	Ex. 2	Ex. 3
HK-90	0.1029	7.40	10.34	7.05	0.89	0.80	1.08	4.49	4.72	3.50
90-110	0.1029	4.34	5.39	4.10	0.31	0.43	1.10	2.57	2.65	2.35
110-130	0.1029	3.80	4.42	2.04	1.05	0.05	1.61	2.05	2.23	2.30
130-140	0.1029	1.93	1.93	2.03	0.92	0.03	0.89	1.29	1.32	1.30
140-150	0.1029	1.56	1.32	3.84	0.56	0.07	0.80	1.49	1.37	1.28
150-170	0.1029	3.45	3.80	5.30	1.95	0.33	1.99	2.90	2.88	2.50
170-190	0.0618	3.82	2.98	3.53	1.88	0.56	1.98	2.47	2.48	2.40
190-210	0.0618	2.58	2.75	3.40	1.77	0.75	2.34	2.31	2.31	2.30
210-230	0.0618	4.77	3.23	3.71	2.46	0.95	2.20	2.87	2.88	2.80
230-250	0.0618	3.35	4.81	5.71	3.24	1.23	3.09	3.66	3.72	3.50
250-275	0.0618	4.88	5.19	3.89	4.73	2.12	3.93	4.06	4.24	4.30
275-300	0.0206	4.71	5.54	5.07	4.25	2.91	4.99	4.57	4.67	4.50
300-325	0.0206	5.05	5.90	5.02	5.22	3.71	4.22	4.83	4.95	5.10
325-350	0.0206	4.92	4.85	3.80	4.52	4.46	4.03	4.37	4.43	4.90
350-400	0.0041	4.30	6.11	4.77	4.53	3.88	4.78	4.70	4.83	5.90
400-450	0.0041	10.65	11.02	10.61	17.00	9.63	10.35	11.53	11.87	12.00
450-500	0.0041	7.27	6.94	6.64	12.88	11.65	10.13	9.23	9.29	9.40
>500	0.0000	20.38	12.68	18.72	31.44	54.22	41.13	29.88	28.49	29.67

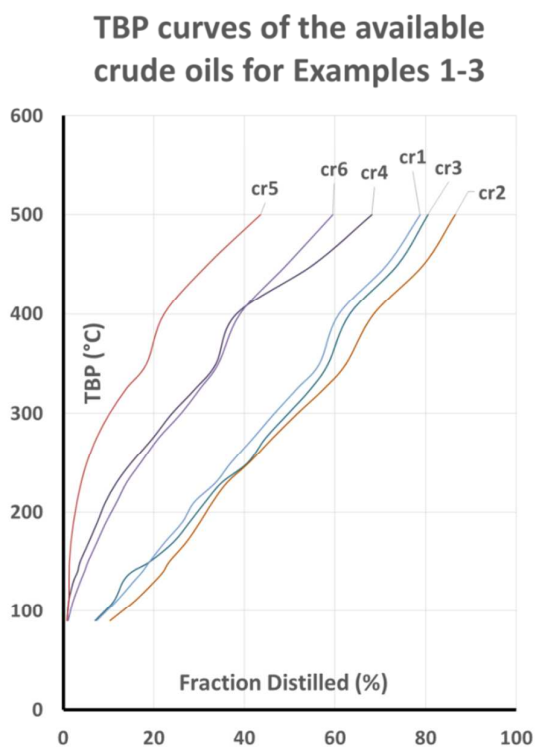


Figure S1. TBP curves of the crude oils available for Examples 1-3

I.2 Comparing the results obtained with the simultaneous and sequential approaches

Table S3. Model sizes for Examples 1-14

Example	Approach	# slots	MILP model			NLP model	
			BV	CV	Eq.	CV	Eq.
1	Simultaneous	5	1628	2111	15161	3345	14549
	Sequential ^(*)	6	392	779	4140	937	3744
2 - 3	Simultaneous	5	2620	2863	31105	4981	30313
	Sequential ^(*)	6	590	1039	7557	1341	7071
4		9	1427	2008	32028	2985	31272
5		8	1219	1718	23321	2541	22655
6		9	1427	2008	32028	2985	31272
7		8	1217	1720	23321	2541	22655
8	Sequential ^(*)	8	1219	1718	23321	2541	22655
9		8	1215	1722	23321	2541	22655
10		8	1218	1719	23321	2541	22655
11		9	1427	2008	32028	2985	31272
12		8	1215	1722	23321	2541	22655

(*) Size of the largest MCOBS scheduling subproblem

Table S4. Comparing results for Examples 1-3 using simultaneous and sequential approaches

Example	Approach	CDU	# tanks	# slots	Best MILP-NLP solution	MILP model		NLP model
						CPU time (s)	Gap (%)	CPU time (s)
Example 1	Simultaneous	CDU ₁	16	8	1.84	1.2	-	0.14
		CDU ₂			1.62			
	Sequential	CDU ₁	8	5	2.24	1.9	-	0.19
		CDU ₂	8	5	1.74	1.9	-	0.06
Example 2	Simultaneous	CDU ₁	20	10	2.52	3600*	29.0	0.38
		CDU ₂			3.13			
	Sequential	CDU ₁	10	6	2.94	2.3	-	0.14
		CDU ₂	10	6	1.82	2.2	-	0.03
Example 3	Simultaneous	CDU ₁	20	10	2.36	3600*	20.0	0.31
		CDU ₂			5.08			
	Sequential	CDU ₁	10	7	3.79	45.2	-	0.53
		CDU ₂	10	5	4.46	1.0	-	0.05

(*) CPU time limit

Table S5. Total quadratic deviations at the best solutions for Examples 1-3 using simultaneous and sequential approaches

Example	Approach	CDU	# tranf. lines	# tanks	# slots	qdev ₁	qdev ₂	qdev ₁ + qdev ₂
Example 1	Simultaneous	CDU ₁	2	16	8	0.99	0.85	1.84
		CDU ₂				1.03	0.59	1.62
	Sequential	CDU ₁	2	8	5	1.18	1.06	2.24
		CDU ₂	2	8	5	0.77	0.97	1.74
Example 2	Simultaneous	CDU ₁	2	20	10	1.44	1.08	2.52
		CDU ₂	2			1.58	1.55	3.13
	Sequential	CDU ₁	2	10	6	1.48	1.46	2.94
		CDU ₂	2	10	6	0.89	0.93	1.82
Example 3	Simultaneous	CDU ₁	2	20	10	1.27	1.09	2.36
		CDU ₂	2			3.05	2.03	5.08
	Sequential	CDU ₁	2	10	7	2.68	1.11	3.79
		CDU ₂	2	10	5	2.69	1.77	4.46

qdev1 = quadratic deviation from the desired TBP ; qdev2 = quadratic TBP change in two consecutive feedstocks

I.3 Detailed results found for Example 1 using the simultaneous approach

Table S6. MCOBS schedule for CDU₁ at the best solution to Example 1 using 4 time slots

		Best feedstock sequence for CDU ₁			
		f ₁	f ₂	f ₃	f ₄
start time (day)		0	5.00	9.17	11.67
end time (day)		5.00	9.17	11.67	15.83
added tank in	p ₁	tk ₁₄	tk ₃	tk ₁₂	tk ₂
	p ₂	tk ₈	tk ₁₆	tk ₅	tk ₁₀
tank sequence in	p ₁	tk ₁₄	tk ₃	tk ₁₂	tk ₂
	p ₂	tk ₈	tk ₁₆	tk ₅	tk ₁₀
emptied tank in	p ₁	tk ₁₄	tk ₃	tk ₁₂	tk ₂
	p ₂	tk ₈	tk ₁₆	tk ₅	tk ₁₀
crude oil in	p ₁	cr ₃	cr ₃	cr ₃	cr ₂
	p ₂	cr ₅	cr ₅	cr ₅	cr ₆
flow rate in	p ₁	250.0	300.0	333.3	200.0
(m ³ /h)	p ₂	250.0	200.0	166.7	300.0
batch size	p ₁	30,000	30,000	20,000	20,000
(m ³)	p ₂	30,000	20,000	10,000	30,000
sulfur (ppm)		1444	1325	1245	766

Table S7. Microcut yields of the feedstocks for CDU₁ at the best solution to Example 1

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)				Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	
HK-90	3.92	4.55	4.97	4.78	4.49
90-110	2.26	2.63	2.88	2.82	2.57
110-130	1.04	1.24	1.38	2.73	2.05
130-140	1.03	1.23	1.36	1.31	1.29
140-150	1.95	2.33	2.58	1.01	1.49
150-170	2.81	3.31	3.64	2.71	2.90
170-190	2.04	2.34	2.54	2.38	2.47
190-210	2.07	2.34	2.52	2.50	2.31
210-230	2.33	2.61	2.79	2.61	2.87
230-250	3.47	3.92	4.22	3.78	3.66
250-275	3.00	3.18	3.30	4.43	4.06
275-300	3.99	4.21	4.35	5.21	4.57
300-325	4.36	4.50	4.58	4.89	4.83
325-350	4.13	4.06	4.02	4.36	4.37
350-400	4.32	4.41	4.47	5.31	4.70
400-450	10.12	10.22	10.28	10.62	11.53
450-500	9.14	8.64	8.31	8.85	9.23
>500	36.47	32.92	30.55	29.75	29.88

Table S8. TBP data of the feedstocks for CDU₁ at the best solution to Example 1

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)				<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	
90	3.92	4.55	4.97	4.78	4.49
110	6.19	7.18	7.84	7.60	7.06
130	7.23	8.43	9.22	10.33	9.11
140	8.26	9.66	10.58	11.64	10.40
150	10.22	11.99	13.17	12.65	11.89
170	13.03	15.30	16.81	15.36	14.79
190	15.08	17.64	19.35	17.74	17.26
210	17.15	19.98	21.87	20.25	19.57
230	19.48	22.59	24.66	22.86	22.44
250	22.95	26.51	28.87	26.64	26.10
275	25.96	29.69	32.17	31.07	30.16
300	29.95	33.89	36.52	36.28	34.73
325	34.31	38.39	41.11	41.17	39.56
350	38.44	42.45	45.13	45.53	43.93
400	42.77	46.87	49.60	40.84	48.63
450	52.89	57.09	59.88	61.46	60.16
500	62.03	65.73	68.19	70.31	69.39

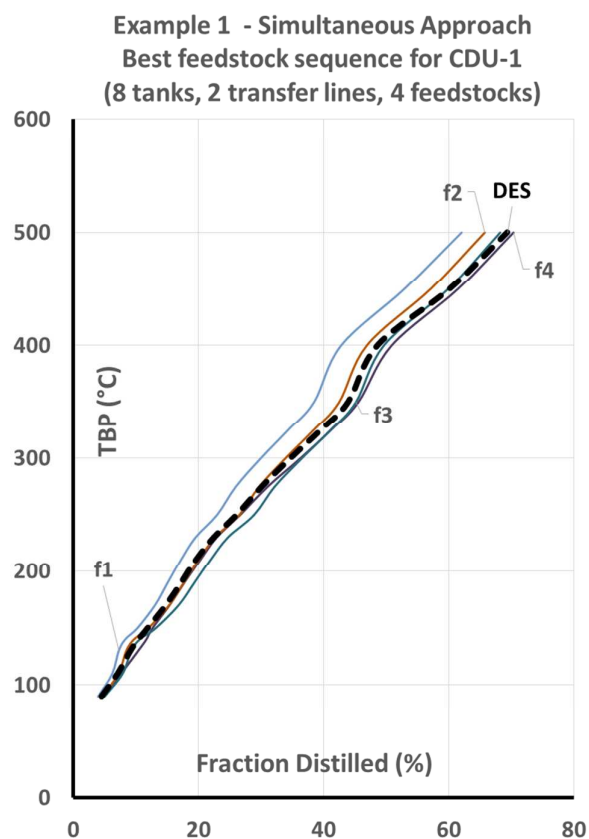


Figure S2. Best solution for CDU₁ at Example 1 using the simultaneous approach

Table S9. MCOBS schedule for CDU₂ at the best solution to Example 1

		Best feedstock sequence for CDU ₂			
		f ₁	f ₂	f ₃	f ₄
start time (day)		0	2.92	5.83	9.17
end time (day)		2.92	5.83	9.17	14.17
added tank in	p ₁	tk ₁₃	tk ₁	tk ₇	tk ₉
	p ₂	tk ₄	tk ₁₁	tk ₁₅	tk ₆
tank sequence in	p ₁	tk ₁₃	tk ₁	tk ₇	tk ₉
	p ₂	tk ₄	tk ₁₁	tk ₁₅	tk ₆
emptied tank in	p ₁	tk ₁₃	tk ₁	tk ₇	tk ₉
	p ₂	tk ₄	tk ₁₁	tk ₁₅	tk ₆
crude oil in	p ₁	cr ₁	cr ₁	cr ₁	cr ₂
	p ₂	cr ₄	cr ₄	cr ₄	cr ₆
flow rate in	p ₁	214.3	214.3	250.0	250.0
(m ³ /h)	p ₂	285.7	285.7	250.0	250.0
batch size	p ₁	15,000	15,000	20,000	30,000
(m ³)	p ₂	20,000	20,000	20,000	30,000
sulfur (ppm)		1104	1104	1156	820

Table S10. Microcut yields of the feedstocks for CDU₂ at the best solution to Example 1

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)				Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	
HK-90	3.68	3.68	4.14	5.71	4.49
90-110	2.04	2.04	2.32	3.24	2.57
110-130	2.23	2.23	2.42	3.01	2.05
130-140	1.35	1.35	1.42	1.41	1.29
140-150	0.99	0.99	1.06	1.06	1.49
150-170	2.59	2.59	2.70	2.89	2.90
170-190	2.71	2.71	2.85	2.48	2.47
190-210	2.12	2.12	2.17	2.54	2.31
210-230	3.45	3.45	3.61	2.71	2.87
230-250	3.29	3.29	3.29	3.95	3.66
250-275	4.79	4.79	4.80	4.56	4.06
275-300	4.45	4.45	4.48	5.26	4.57
300-325	5.15	5.15	5.13	5.06	4.83
325-350	4.69	4.69	4.72	4.44	4.37
350-400	4.43	4.43	4.41	5.44	4.70
400-450	14.28	14.28	13.82	10.68	11.53
450-500	10.48	10.48	10.07	8.53	9.23
>500	26.70	26.70	25.91	26.90	29.88

Table S11. TBP data of the feedstocks for CDU₂ at the best solution to Example 1

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)				<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	
90	3.68	3.68	4.14	5.71	4.49
110	5.72	5.72	6.47	8.95	7.06
130	7.95	7.95	8.89	11.97	9.11
140	9.30	9.30	10.32	13.38	10.40
150	10.29	10.29	11.38	14.44	11.89
170	12.88	12.88	14.08	17.33	14.79
190	15.59	15.59	16.93	19.81	17.26
210	17.71	17.71	19.10	22.36	19.57
230	21.16	21.16	22.72	25.07	22.44
250	24.45	24.45	26.01	29.02	26.10
275	29.24	29.24	30.82	33.58	30.16
300	33.69	33.69	35.30	38.85	34.73
325	38.83	38.83	40.43	43.91	39.56
350	43.53	43.53	45.15	48.35	43.93
400	47.96	47.96	49.57	53.79	48.63
450	62.24	62.24	63.39	64.48	60.16
500	72.71	72.71	73.47	73.01	69.39

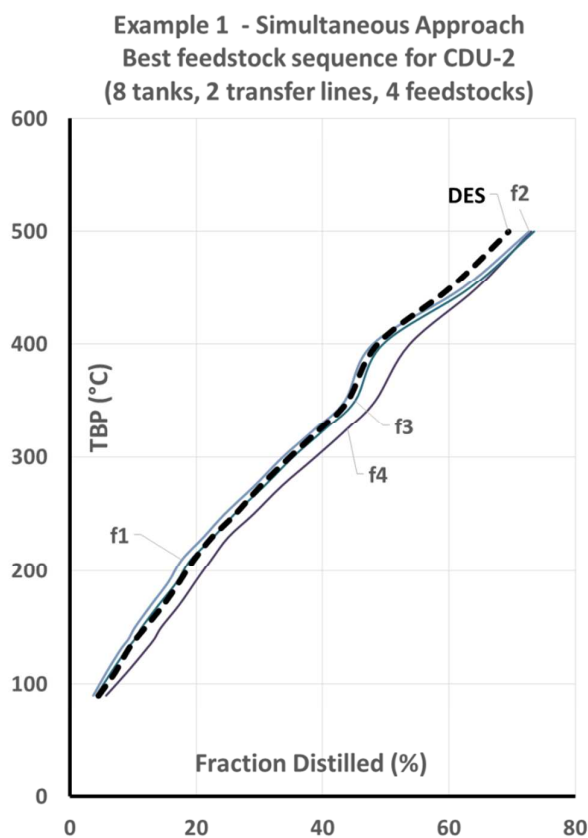


Figure S3. Best solution for CDU₂ at Example 1 using the simultaneous approach

I.4 Detailed computational results for Example 1 using the sequential approach

Table S12. MCOBS schedule for CDU₁ at the best solution to Example 1 using 5 time slots

		Best feedstock sequence for CDU ₁				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	3.01	5.61	7.50	10.83
end time (day)		3.01	5.61	7.50	10.83	14.17
added tank in	p ₁	tk ₁₂	tk ₃	-	tk ₇	tk ₂
	p ₂	tk ₈	-	tk ₅	tk ₄	tk ₁₅
tank sequence in	p ₁	tk ₁₂	tk ₃	tk ₃	tk ₇	tk ₂
	p ₂	tk ₈	tk ₈	tk ₅	tk ₄	tk ₁₅
emptied tank in	p ₁	tk ₁₂	-	tk ₃	tk ₇	tk ₂
	p ₂	-	tk ₈	tk ₅	tk ₄	tk ₁₅
crude oil in	p ₁	cr ₃	cr ₃	cr ₃	cr ₁	cr ₂
	p ₂	cr ₅	cr ₅	cr ₅	cr ₄	cr ₄
flow rate in	p ₁	276.7	278.0	279.2	250.0	250.0
(m ³ /h)	p ₂	223.3	222.0	220.8	250.0	250.0
batch size	p ₁	20,000	17,352	12,648	20,000	20,000
(m ³)	p ₂	16,140	13,860	10,000	20,000	20,000
sulfur (ppm)		1380	1377	1374	1156	941

Table S13. Microcut yields of the feedstocks for CDU₁ at the best solution to Example 1

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	4.26	4.27	4.29	4.14	5.61	4.49
90-110	2.46	2.47	2.48	2.32	2.85	2.57
110-130	1.15	1.16	1.16	2.42	2.73	2.05
130-140	1.14	1.14	1.15	1.42	1.42	1.29
140-150	2.16	2.17	2.17	1.06	0.94	1.49
150-170	3.08	3.09	3.11	2.70	2.87	2.90
170-190	2.20	2.21	2.22	2.85	2.43	2.47
190-210	2.22	2.22	2.23	2.17	2.26	2.31
210-230	2.48	2.48	2.49	3.61	2.84	2.87
230-250	3.71	3.72	3.73	3.29	4.02	3.66
250-275	3.10	3.10	3.11	4.80	4.96	4.06
275-300	4.10	4.11	4.12	4.48	4.89	4.57
300-325	4.43	4.44	4.44	5.13	5.56	4.83
325-350	4.09	4.09	4.09	4.72	4.68	4.37
350-400	4.37	4.37	4.38	4.41	5.32	4.70
400-450	10.17	10.17	10.18	13.82	14.01	11.53
450-500	8.88	8.86	8.85	10.07	9.91	9.23
>500	34.57	34.48	34.39	25.91	22.06	29.88

Table S14. TBP data of the feedstocks for CDU₁ at the best solution to Example 1

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	4.26	4.27	4.29	4.14	5.61	4.49
110	6.72	6.74	6.77	6.47	8.46	7.06
130	7.87	7.90	7.93	8.89	11.20	9.11
140	9.01	9.04	9.08	10.32	12.62	10.40
150	11.16	11.21	11.25	11.38	13.56	11.89
170	14.24	14.30	14.36	14.08	16.44	14.79
190	16.45	16.51	16.58	16.93	18.87	17.26
210	18.66	18.74	18.81	19.10	21.13	19.57
230	21.14	21.22	21.30	22.72	23.97	22.44
250	24.85	24.94	25.03	26.01	28.00	26.10
275	27.95	28.04	28.14	30.82	32.96	30.16
300	32.06	31.16	32.26	35.30	37.85	34.73
325	36.49	36.59	36.70	40.43	43.41	39.56
350	40.59	40.69	40.79	45.15	48.10	43.93
400	44.96	45.06	45.17	49.57	53.42	48.63
450	55.13	55.24	55.34	63.39	67.43	60.16
500	64.01	64.10	64.19	73.47	77.34	69.39

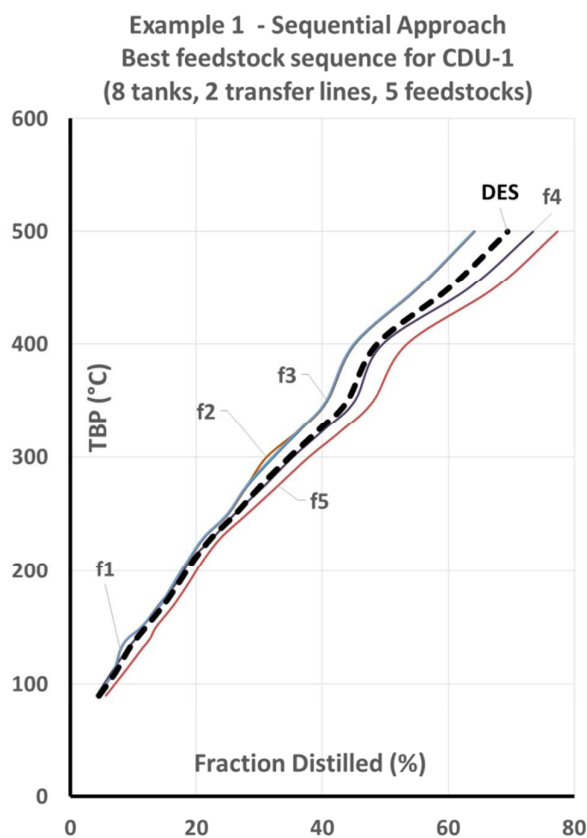


Figure S4. Best solution for CDU₁ at Example 1 using the sequential approach

Table S15. MCOBS schedule for CDU₂ at the best solution to Example 1 using 5 time slots

		Best feedstock sequence for CDU ₂				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	4.17	6.94	10.83	13.34
end time (day)		4.17	6.94	10.83	13.34	15.83
added tank in	p ₁	tk ₁₄	tk ₉	-	tk ₁	tk ₁₃
	p ₂	tk ₁₆	tk ₁₁	tk ₆	tk ₁₀	-
tank sequence in	p ₁	tk ₁₄	tk ₉	tk ₉	tk ₁	tk ₁₃
	p ₂	tk ₁₆	tk ₁₁	tk ₆	tk ₁₀	tk ₁₀
emptied tank in	p ₁	tk ₁₄	-	tk ₉	tk ₁	tk ₁₃
	p ₂	tk ₁₆	tk ₁₁	tk ₆	-	tk ₁₀
crude oil in	p ₁	cr ₃	cr ₂	cr ₂	cr ₁	cr ₁
	p ₂	cr ₅	cr ₄	cr ₆	cr ₆	cr ₆
flow rate in	p ₁	300.0	199.5	178.9	248.8	251.2
(m ³ /h)	p ₂	200.0	300.5	321.1	251.2	248.8
batch size	p ₁	30,000	13,283	16,717	15,000	15,000
(m ³)	p ₂	20,000	20,000	30,000	15,142	14,858
sulfur (ppm)		1325	911	743	1033	1037

Table S16. Microcut yields of the feedstocks for CDU₂ at the best solution to Example 1

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	4.55	4.66	4.39	4.22	4.25	4.49
90-110	2.63	2.34	2.63	2.71	2.73	2.57
110-130	1.24	2.39	2.62	2.70	2.71	2.05
130-140	1.23	1.32	1.26	1.41	1.41	1.29
140-150	2.33	0.86	0.99	1.18	1.18	1.49
150-170	3.31	2.69	2.64	2.72	2.72	2.90
170-190	2.34	2.32	2.34	2.90	2.90	2.47
190-210	2.34	2.16	2.49	2.46	2.46	2.31
210-230	2.61	2.77	2.57	3.48	3.49	2.87
230-250	3.92	3.87	3.70	3.22	3.22	3.66
250-275	3.18	4.91	4.38	4.40	4.41	4.06
275-300	4.21	4.76	5.19	4.85	4.85	4.57
300-325	4.50	5.49	4.82	4.63	4.64	4.83
325-350	4.06	4.65	4.32	4.47	4.48	4.37
350-400	4.41	5.16	5.26	4.54	4.54	4.70
400-450	10.22	14.61	10.59	10.50	10.50	11.53
450-500	8.64	10.51	8.99	8.71	8.69	9.23
>500	32.92	23.95	30.95	30.80	30.71	29.88

Table S17. TBP data of the feedstocks for CDU₂ at the best solution to Example 1

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	4.55	4.66	4.39	4.22	4.25	4.49
110	7.18	7.00	7.03	6.94	6.98	7.06
130	8.43	9.39	9.64	9.64	9.69	9.11
140	9.66	10.72	10.91	11.04	11.10	10.40
150	11.99	11.58	11.89	12.22	12.29	11.89
170	15.30	14.27	14.53	14.94	15.01	14.79
190	17.64	16.59	16.87	17.83	17.91	17.26
210	19.98	18.75	19.35	20.29	20.38	19.57
230	22.59	21.52	21.92	23.77	23.87	22.44
250	26.51	25.38	25.63	26.99	27.09	26.10
275	29.69	30.30	30.01	31.40	31.49	30.16
300	33.89	35.06	35.20	36.25	36.34	34.73
325	38.39	40.55	40.02	40.88	40.98	39.56
350	42.45	45.20	44.34	45.35	45.46	43.93
400	46.87	50.36	49.60	49.89	50.00	48.63
450	57.09	64.98	60.19	60.39	60.50	60.16
500	65.73	75.49	69.17	69.10	69.19	69.39

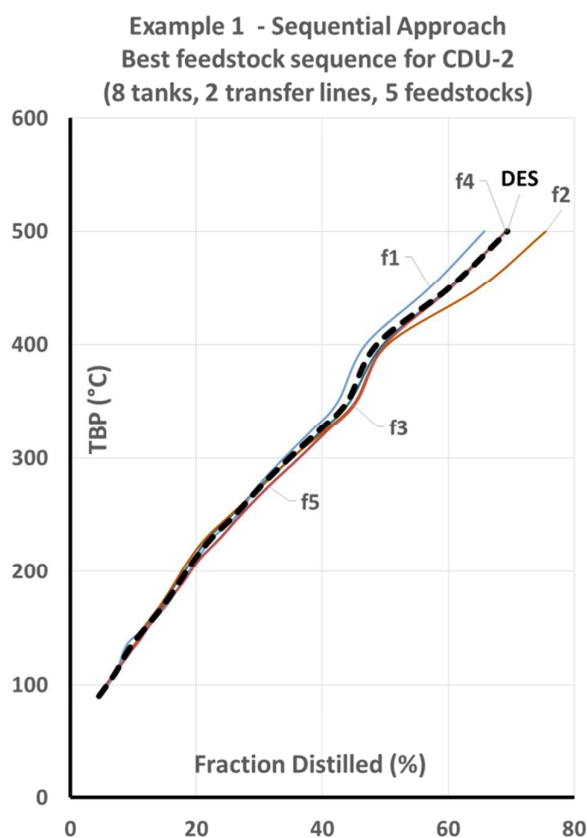


Figure S5. Best solution for CDU₂ at Example 1 using the sequential approach

I.5 Detailed computational results for Example 2 using the simultaneous approach

Table S18. MCOBS schedule for CDU₁ at the best solution to Example 2 using 5 time slots

		Best feedstock sequence for CDU ₁				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	3.75	6.25	9.17	15.00
end time (day)		3.75	6.25	9.17	15.00	19.17
added tank in	p ₁	tk ₁₃	tk ₁₈	tk ₁	tk ₉	tk ₃
	p ₂	tk ₁₀	tk ₁₉	tk ₄	tk ₂₀	tk ₁₅
tank sequence in	p ₁	tk ₁₃	tk ₁₈	tk ₁	tk ₉	tk ₃
	p ₂	tk ₁₀	tk ₁₉	tk ₄	tk ₂₀	tk ₁₅
emptied tank in	p ₁	tk ₁₃	tk ₁₈	tk ₁	tk ₉	tk ₃
	p ₂	tk ₁₀	tk ₁₉	tk ₄	tk ₂₀	tk ₁₅
crude oil in	p ₁	cr ₁	cr ₁	cr ₁	cr ₂	cr ₃
	p ₂	cr ₆	cr ₆	cr ₄	cr ₄	cr ₄
flow rate in	p ₁	166.7	166.7	214.3	214.3	300.0
(m ³ /h)	p ₂	333.3	333.3	285.7	285.7	200.0
batch size	p ₁	15,000	10,000	15,000	30,000	30,000
(m ³)	p ₂	30,000	20,000	20,000	40,000	20,000
sulfur (ppm)		874	874	1104	920	826

Table S19. Microcut yields of the feedstocks for CDU₁ at the best solution to Example 2

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	3.19	3.19	3.68	4.94	4.59	4.72
90-110	2.18	2.18	2.04	2.49	2.58	2.65
110-130	2.34	2.34	2.23	2.49	1.64	2.23
130-140	1.24	1.24	1.35	1.35	1.59	1.32
140-150	1.05	1.05	0.99	0.89	2.53	1.37
150-170	2.48	2.48	2.59	2.74	3.96	2.88
170-190	2.59	2.59	2.71	2.35	2.87	2.48
190-210	2.42	2.42	2.12	2.19	2.75	2.31
210-230	3.06	3.06	3.45	2.79	3.21	2.88
230-250	3.18	3.18	3.29	3.91	4.72	3.72
250-275	4.25	4.25	4.79	4.93	4.23	4.24
275-300	4.90	4.90	4.45	4.80	4.74	4.67
300-325	4.50	4.50	5.15	5.51	5.10	4.95
325-350	4.33	4.33	4.69	4.66	4.09	4.43
350-400	4.62	4.62	4.43	5.21	4.67	4.83
400-450	10.45	10.45	14.28	14.44	13.17	11.87
450-500	9.18	9.18	10.48	10.33	9.14	9.29
>500	34.21	34.21	26.70	23.40	23.81	28.49

Table S20. TBP data of the feedstocks for CDU₁ at the best solution to Example 2

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	3.19	3.19	3.68	4.94	4.59	4.72
110	5.37	5.37	5.72	7.42	7.17	7.37
130	7.71	7.71	7.95	9.92	8.81	9.60
140	8.94	8.94	9.30	11.27	10.40	10.92
150	10.00	10.00	10.29	12.16	12.93	12.29
170	12.47	12.47	12.88	14.90	16.89	15.17
190	15.07	15.07	15.59	17.25	19.76	17.65
210	17.49	17.49	17.71	19.44	22.51	19.96
230	20.54	20.54	21.16	22.23	25.72	22.84
250	23.72	23.72	24.45	26.15	30.44	26.56
275	27.97	27.97	29.24	31.07	34.66	30.80
300	32.86	32.86	33.69	35.88	39.41	35.47
325	37.36	37.36	38.83	41.39	44.51	40.42
350	41.69	41.69	43.53	46.05	48.59	44.85
400	46.31	46.31	47.96	51.26	53.27	49.68
450	56.76	56.76	62.24	65.69	66.43	61.55
500	65.93	65.93	72.71	76.03	75.57	70.84

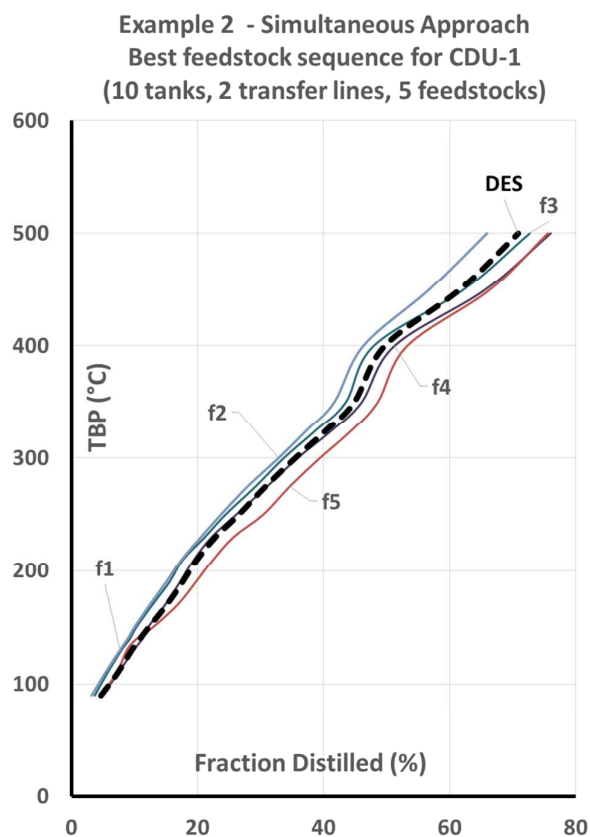


Figure S6. Best solution for CDU₁ at Example 2 using the simultaneous approach

Table S21. MCOBS schedule for CDU₂ at the best solution to Example 2 using the 5 time slots

		Best feedstock sequence for CDU ₂				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	2.50	6.67	10.00	14.17
end time (day)		2.50	6.67	10.00	14.17	20.83
added tank in	p ₁	tk ₁₂	tk ₁₄	tk ₇	tk ₂	tk ₁₇
	p ₂	tk ₅	tk ₁₆	tk ₁₁	tk ₆	tk ₈
tank sequence in	p ₁	tk ₁₂	tk ₁₄	tk ₇	tk ₂	tk ₁₇
	p ₂	tk ₅	tk ₁₆	tk ₁₁	tk ₆	tk ₈
emptied tank in	p ₁	tk ₁₂	tk ₁₄	tk ₇	tk ₂	tk ₁₇
	p ₂	tk ₅	tk ₁₆	tk ₁₁	tk ₆	tk ₈
crude oil in	p ₁	cr ₃	cr ₃	cr ₁	cr ₂	cr ₂
	p ₂	cr ₅	cr ₅	cr ₄	cr ₆	cr ₅
flow rate in	p ₁	333.3	300.0	250.0	200.0	312.5
(m ³ /h)	p ₂	166.7	200.0	250.0	300.0	187.5
batch size	p ₁	20,000	30,000	20,000	20,000	50,000
(m ³)	p ₂	10,000	20,000	20,000	30,000	30,000
sulfur (ppm)		1245	1325	1156	766	1444

Table S22. Microcut yields of the feedstocks for CDU₂ at the best solution to Example 2

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	4.97	4.55	4.14	4.78	6.76	4.72
90-110	2.88	2.63	2.32	2.82	3.53	2.65
110-130	1.38	1.24	2.42	2.73	2.78	2.23
130-140	1.36	1.23	1.42	1.31	1.22	1.32
140-150	2.58	2.33	1.06	1.01	0.85	1.37
150-170	3.64	3.31	2.70	2.71	2.50	2.88
170-190	2.54	2.34	2.85	2.38	2.07	2.48
190-210	2.52	2.34	2.17	2.50	2.00	2.31
210-230	2.79	2.61	3.61	2.61	2.37	2.88
230-250	4.22	3.92	3.29	3.78	3.47	3.72
250-275	3.30	3.18	4.80	4.43	4.04	4.24
275-300	4.35	4.21	4.48	5.21	4.55	4.67
300-325	4.58	4.50	5.13	4.89	5.08	4.95
325-350	4.02	4.06	4.72	4.36	4.70	4.43
350-400	4.47	4.41	4.41	5.31	5.27	4.83
400-450	10.28	10.22	13.82	10.62	10.50	11.87
450-500	8.31	8.64	10.07	8.85	8.71	9.29
>500	30.55	32.92	25.91	29.75	28.26	28.49

Table S23. TBP data of the feedstocks for CDU₂ at the best solution to Example 2

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	4.97	4.55	4.14	4.78	6.76	4.72
110	7.84	7.18	6.47	7.60	10.29	7.37
130	9.22	8.43	8.89	10.33	13.07	9.60
140	10.58	9.66	10.32	11.64	14.29	10.92
150	13.17	11.99	11.38	12.65	15.14	12.29
170	16.81	15.30	14.08	15.36	17.64	15.17
190	19.35	17.64	16.93	17.74	19.71	17.65
210	21.87	19.98	19.10	20.25	21.71	19.96
230	24.66	22.59	22.72	22.86	24.09	22.84
250	28.87	26.51	26.01	26.64	27.56	26.56
275	32.17	29.69	30.82	31.07	31.59	30.80
300	36.52	33.89	35.30	36.28	36.15	35.47
325	41.11	38.39	40.43	41.17	41.23	40.42
350	45.13	42.45	45.15	45.53	45.93	44.85
400	49.60	46.87	49.57	50.84	51.20	49.68
450	59.88	57.09	63.39	61.46	61.70	61.55
500	68.19	65.73	73.47	70.31	70.41	70.84

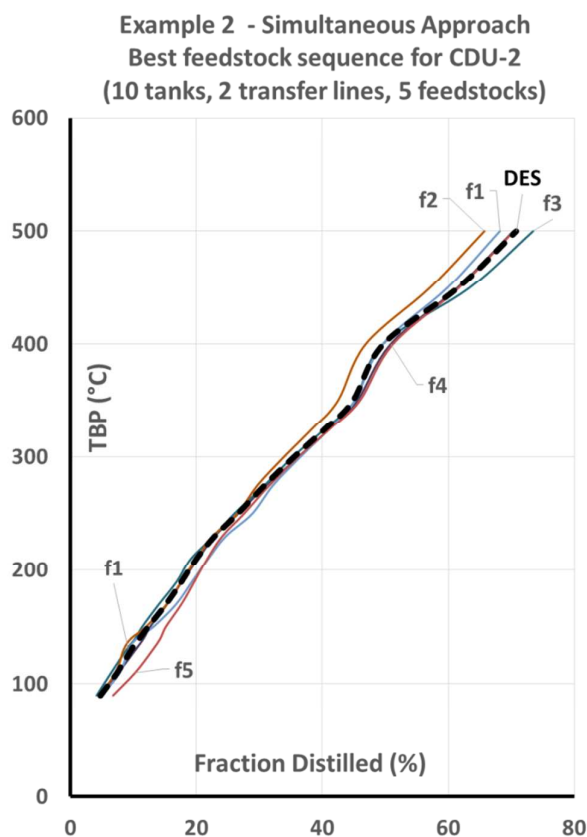


Figure S7. Best solution for CDU₂ at Example 2 using the simultaneous approach

I.6 Detailed computational results for Example 2 using the sequential approach

Table S24. MCOBS schedule for CDU₁ at the best solution to Example 2 using 6 time slots

		Best feedstock sequence for CDU ₁					
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆
start time (day)		0	3.90	6.67	8.33	11.67	14.64
end time (day)		3.90	6.67	8.33	11.67	14.64	20.83
added tank in	p ₁	tk ₃	tk ₁₂	tk ₁₈	tk ₇	tk ₁₇	tk ₁₇
	p ₂	tk ₈	-	tk ₅	tk ₁₉	tk ₁₅	tk ₂₀
tank sequence in	p ₁	tk ₃	tk ₁₂	tk ₁₈	tk ₇	tk ₁₇	tk ₁₇
	p ₂	tk ₈	tk ₈	tk ₅	tk ₁₉	tk ₁₅	tk ₂₀
emptied tank in	p ₁	tk ₃	tk ₁₂	tk ₁₈	tk ₇	tk ₁₇	tk ₁₇
	p ₂	-	tk ₈	tk ₅	tk ₁₉	tk ₁₅	tk ₂₀
crude oil in	p ₁	cr ₃	cr ₃	cr ₁	cr ₁	cr ₂	cr ₂
	p ₂	cr ₅	cr ₅	cr ₅	cr ₆	cr ₄	cr ₄
flow rate in	p ₁	320.8	300.8	250.0	250.0	219.7	230.9
(m ³ /h)	p ₂	179.2	199.2	250.0	250.0	280.3	269.1
batch size	p ₁	30,000	20,000	10,000	20,000	15,676	34,324
(m ³)	p ₂	16,755	13,245	10,000	20,000	20,000	40,000
sulfur (ppm)		1275	1323	1779	1035	923	929

Table S25. Microcut yields of the feedstocks for CDU₁ at the best solution to Example 2

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)						Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	
HK-90	4.81	4.56	4.10	4.24	5.04	5.25	4.72
90-110	2.78	2.64	2.38	2.72	2.54	2.66	2.65
110-130	1.33	1.25	1.92	2.70	2.53	2.61	2.23
130-140	1.31	1.23	0.98	1.41	1.36	1.39	1.32
140-150	2.49	2.34	0.81	1.18	0.89	0.91	1.37
150-170	3.52	3.32	1.89	2.72	2.76	2.80	2.88
170-190	2.47	2.35	2.19	2.90	2.36	2.39	2.48
190-210	2.45	2.34	1.66	2.46	2.20	2.22	2.31
210-230	2.72	2.61	2.86	3.48	2.80	2.82	2.88
230-250	4.10	3.92	2.29	3.22	3.93	3.96	3.72
250-275	3.26	3.18	3.50	4.40	4.93	4.94	4.24
275-300	4.30	4.21	3.81	4.85	4.82	4.85	4.67
300-325	4.55	4.50	4.38	4.63	5.52	5.53	4.95
325-350	4.04	4.06	4.69	4.47	4.66	4.67	4.43
350-400	4.45	4.41	4.09	4.54	5.22	5.26	4.83
400-450	10.26	10.22	10.14	10.50	14.37	14.24	11.87
450-500	8.43	8.64	9.46	8.70	10.27	10.14	9.29
>500	31.44	32.86	37.30	30.75	23.20	22.78	28.49

Table S26. TBP data of the feedstocks for CDU₁ at the best solution to Example 2

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)						<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	
90	4.81	4.56	4.10	4.24	5.04	5.25	4.72
110	7.59	7.20	6.58	6.96	7.58	7.91	7.37
130	8.92	8.44	8.41	9.66	10.11	10.52	9.60
140	10.23	9.68	9.39	11.07	11.48	11.90	10.92
150	12.72	12.02	10.20	12.25	12.37	12.81	12.29
170	16.24	15.34	12.09	14.97	15.14	15.62	15.17
190	18.71	17.68	14.28	17.87	17.50	18.01	17.65
210	21.16	20.03	15.95	20.33	19.70	20.23	19.96
230	23.88	22.64	18.81	23.82	22.50	23.04	22.84
250	27.98	26.56	21.10	27.04	26.43	27.01	26.56
275	31.24	29.75	24.60	31.44	31.36	31.95	30.80
300	35.54	33.96	28.41	36.29	36.18	36.80	35.47
325	40.09	38.45	32.79	40.93	41.70	42.33	40.42
350	44.12	42.52	37.48	45.40	46.36	47.00	44.85
400	48.57	46.93	41.57	49.94	51.58	52.26	49.68
450	58.83	57.15	51.71	60.44	65.96	66.50	61.55
500	67.27	65.79	61.17	69.14	76.23	76.64	70.84

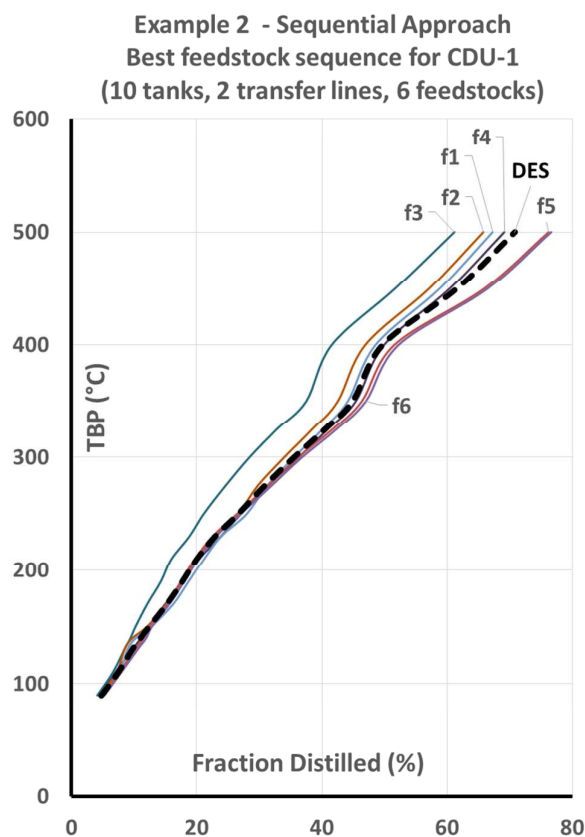


Figure S8. Best solution for CDU₁ at Example 2 using the sequential approach

Table S27. MCOBS schedule for CDU₂ at the best solution to Example 2 using 6 time slots

		Best feedstock sequence for CDU ₂					
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆
start time (day)		0	4.17	8.33	12.21	15.00	17.11
end time (day)		4.17	8.33	12.21	15.00	17.11	19.17
added tank in	p ₁	tk ₁₄	tk ₂	tk ₉	-	tk ₁	tk ₁₃
	p ₂	tk ₁₆	tk ₆	tk ₁₀	tk ₄	tk ₁₁	-
tank sequence in	p ₁	tk ₁₄	tk ₂	tk ₉	tk ₉	tk ₁	tk ₁₃
	p ₂	tk ₁₆	tk ₆	tk ₁₀	tk ₄	tk ₁₁	tk ₁₁
emptied tank in	p ₁	tk ₁₄	tk ₂	-	tk ₉	tk ₁	tk ₁₃
	p ₂	tk ₁₆	tk ₆	tk ₁₀	tk ₄	-	tk ₁₁
crude oil in	p ₁	cr ₃	cr ₂	cr ₂	cr ₂	cr ₁	cr ₁
	p ₂	cr ₅	cr ₆	cr ₆	cr ₄	cr ₄	cr ₄
flow rate in	p ₁	300.0	200.0	177.8	201.0	296.8	303.3
(m ³ /h)	p ₂	200.0	300.0	322.2	299.0	203.2	196.7
batch size	p ₁	30,000	20,000	16,553	13,447	15,000	15,000
(m ³)	p ₂	20,000	30,000	30,000	20,000	10,271	9,729
sulfur (ppm)		1325	766	742	912	1224	1233

Table S28. Microcut yields of the feedstocks for CDU₂ at the best solution to Example 2

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)						Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	
HK-90	4.55	4.78	4.37	4.69	4.75	4.84	4.72
90-110	2.63	2.82	2.62	2.35	2.70	2.75	2.65
110-130	1.24	2.73	2.61	2.40	2.68	2.72	2.23
130-140	1.23	1.31	1.26	1.33	1.52	1.53	1.32
140-150	2.33	1.01	0.98	0.87	1.15	1.17	1.37
150-170	3.31	2.71	2.63	2.69	2.84	2.86	2.88
170-190	2.34	2.38	2.34	2.32	3.03	3.06	2.48
190-210	2.34	2.50	2.49	2.16	2.25	2.26	2.31
210-230	2.61	2.61	2.57	2.77	3.83	3.86	2.88
230-250	3.92	3.78	3.70	3.87	3.30	3.31	3.72
250-275	3.18	4.43	4.38	4.91	4.82	4.82	4.24
275-300	4.21	5.21	5.19	4.77	4.52	4.53	4.67
300-325	4.50	4.89	4.82	5.49	5.12	5.12	4.95
325-350	4.06	4.36	4.32	4.65	4.76	4.76	4.43
350-400	4.41	5.31	5.25	5.16	4.39	4.39	4.83
400-450	10.22	10.62	10.59	14.60	13.23	13.15	11.87
450-500	8.64	8.85	9.00	10.49	9.55	9.48	9.29
>500	32.92	29.75	31.01	23.90	24.87	24.73	28.49

Table S29. TBP data of the feedstocks for CDU₂ at the best solution to Example 2

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)						<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	
90	4.55	4.78	4.37	4.69	4.75	4.84	4.72
110	7.18	7.60	7.00	7.04	7.46	7.59	7.37
130	8.43	10.33	9.61	9.45	10.14	10.31	9.60
140	9.66	11.64	10.87	10.77	11.66	11.84	10.92
150	11.99	12.65	11.85	11.64	12.81	13.01	12.29
170	15.30	15.36	14.48	14.33	15.65	15.87	15.17
190	17.64	17.74	16.82	16.65	18.68	18.92	17.65
210	19.98	20.25	19.31	18.82	20.93	21.19	19.96
230	22.59	22.86	21.87	21.59	24.77	25.05	22.84
250	26.51	26.64	25.57	25.46	28.07	28.36	26.56
275	29.69	31.07	29.95	30.37	32.89	33.18	30.80
300	33.89	36.28	35.14	35.14	37.41	37.71	35.47
325	38.39	41.17	39.96	40.64	42.53	42.82	40.42
350	42.45	45.53	44.28	45.29	47.29	47.59	44.85
400	46.87	50.84	49.53	50.45	51.68	51.98	49.68
450	57.09	61.46	60.12	65.05	64.91	65.12	61.55
500	65.73	70.31	69.11	75.54	74.46	74.60	70.84

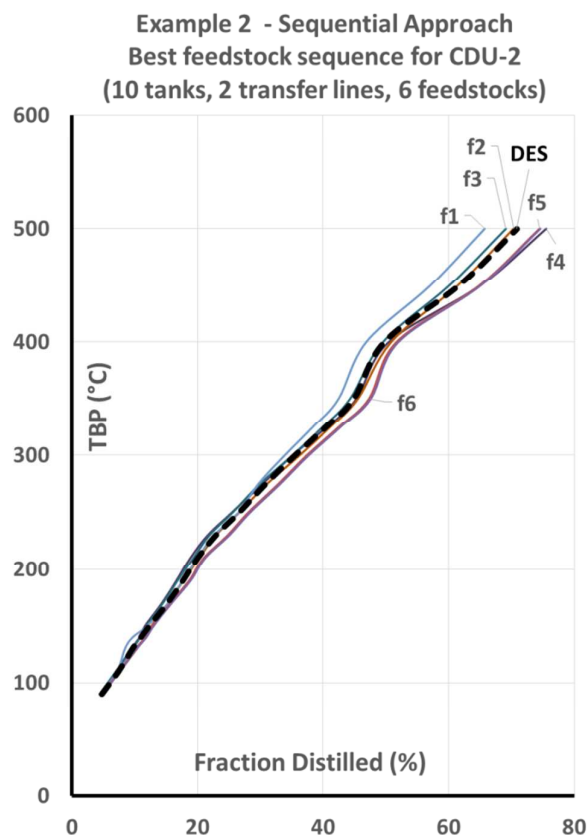


Figure S9. Best solution for CDU₂ at Example 2 using the sequential approach

I.7 Detailed computational results for Example 3 using the simultaneous approach

Table S30. MCOBS schedule for CDU₁ at the best solution to Example 3 using 5 time slots

		Best feedstock sequence for CDU ₁				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	2.50	6.67	9.58	15.42
end time (day)		2.50	6.67	9.58	15.42	19.58
added tank in	p ₁	tk ₁₈	tk ₇	tk ₁₃	tk ₉	tk ₃
	p ₂	tk ₁₉	tk ₆	tk ₁₁	tk ₂₀	tk ₁₅
tank sequence in	p ₁	tk ₁₈	tk ₇	tk ₁₃	tk ₉	tk ₃
	p ₂	tk ₁₉	tk ₆	tk ₁₁	tk ₂₀	tk ₁₅
emptied tank in	p ₁	tk ₁₈	tk ₇	tk ₁₃	tk ₉	tk ₃
	p ₂	tk ₁₉	tk ₆	tk ₁₁	tk ₂₀	tk ₁₅
crude oil in	p ₁	cr ₁	cr ₁	cr ₁	cr ₂	cr ₃
	p ₂	cr ₆	cr ₆	cr ₄	cr ₄	cr ₄
flow rate in	p ₁	166.7	200.0	214.3	214.3	300.0
(m ³ /h)	p ₂	333.3	300.0	285.7	285.7	200.0
batch size	p ₁	10,000	20,000	15,000	30,000	30,000
(m ³)	p ₂	20,000	30,000	20,000	40,000	20,000
sulfur (ppm)		874	938	1104	920	826

Table S31. Microcut yields of the feedstocks for CDU₁ at the best solution to Example 3

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	3.19	3.61	3.68	4.94	4.59	3.50
90-110	2.18	2.40	2.04	2.49	2.58	2.35
110-130	2.34	2.49	2.23	2.49	1.64	2.30
130-140	1.24	1.31	1.35	1.35	1.59	1.30
140-150	1.05	1.10	0.99	0.89	2.53	1.28
150-170	2.48	2.57	2.59	2.74	3.96	2.50
170-190	2.59	2.72	2.71	2.35	2.87	2.40
190-210	2.42	2.44	2.12	2.19	2.75	2.30
210-230	3.06	3.23	3.45	2.79	3.21	2.80
230-250	3.18	3.19	3.29	3.91	4.72	3.50
250-275	4.25	4.31	4.79	4.93	4.23	4.30
275-300	4.90	4.88	4.45	4.80	4.74	4.50
300-325	4.50	4.55	5.15	5.51	5.10	5.10
325-350	4.33	4.39	4.69	4.66	4.09	4.90
350-400	4.62	4.59	4.43	5.21	4.67	5.90
400-450	10.45	10.47	14.28	14.44	13.17	12.00
450-500	9.18	8.99	10.48	10.33	9.14	9.40
>500	34.21	32.83	26.70	23.40	23.81	29.67

Table S32. TBP data of the feedstocks for CDU₁ at the best solution to Example 3

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	3.19	3.61	3.68	4.94	4.59	3.50
110	5.37	6.00	5.72	7.43	7.17	5.85
130	7.71	8.49	7.95	9.92	8.81	8.15
140	8.94	9.80	9.30	11.27	10.40	9.45
150	10.00	10.90	10.29	12.16	12.93	10.73
170	12.47	13.47	12.88	14.90	16.89	13.23
190	15.07	16.19	15.59	17.25	19.76	15.63
210	17.49	18.63	17.71	19.44	22.51	17.93
230	20.54	21.85	21.16	22.23	25.72	20.73
250	23.71	25.05	24.45	26.15	30.44	24.23
275	27.97	29.36	29.24	31.07	34.66	28.53
300	32.86	34.24	33.69	35.88	39.41	33.03
325	37.36	38.79	38.83	41.39	44.51	38.13
350	41.69	43.17	43.53	46.05	48.59	43.03
400	46.31	47.76	47.96	51.26	53.27	48.93
450	56.76	58.23	62.24	65.69	66.43	60.93
500	65.93	67.22	72.71	76.03	75.57	70.33

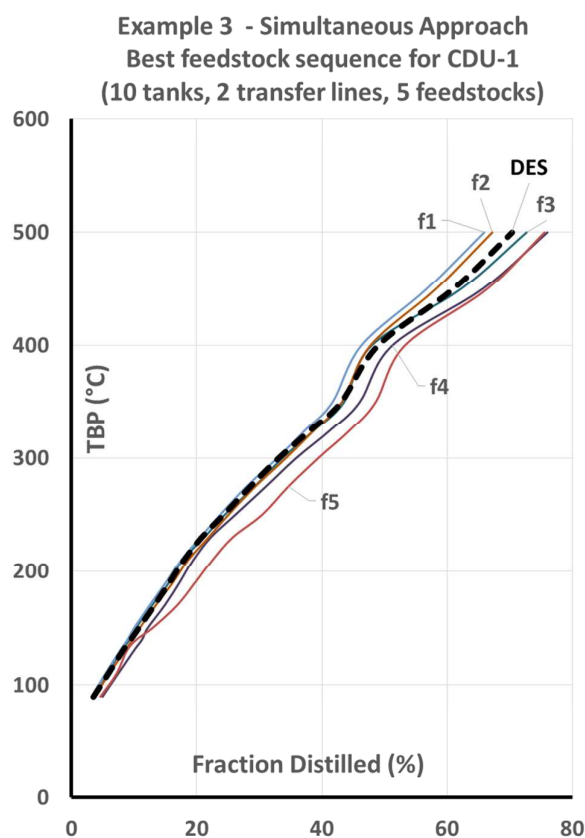


Figure S10. Best solution for CDU₁ at Example 3 using the simultaneous approach

Table S33. MCOBS schedule for CDU₂ at the best solution to Example 3 using 5 time slots

		Best feedstock sequence for CDU ₂				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	2.92	7.08	9.58	13.75
end time (day)		2.92	7.08	9.58	13.75	20.42
added tank in	p ₁	tk ₁	tk ₁₄	tk ₁₂	tk ₂	tk ₁₇
	p ₂	tk ₄	tk ₁₆	tk ₅	tk ₁₀	tk ₈
tank sequence in	p ₁	tk ₁	tk ₁₄	tk ₁₂	tk ₂	tk ₁₇
	p ₂	tk ₄	tk ₁₆	tk ₅	tk ₁₀	tk ₈
emptied tank in	p ₁	tk ₁	tk ₁₄	tk ₁₂	tk ₂	tk ₁₇
	p ₂	tk ₄	tk ₁₆	tk ₅	tk ₁₀	tk ₈
crude oil in	p ₁	cr ₁	cr ₃	cr ₃	cr ₂	cr ₂
	p ₂	cr ₄	cr ₅	cr ₅	cr ₆	cr ₅
flow rate in	p ₁	214.3	300.0	333.3	200.0	312.5
(m ³ /h)	p ₂	285.7	200.0	166.7	300.0	187.5
batch size	p ₁	15,000	30,000	20,000	20,000	50,000
(m ³)	p ₂	20,000	20,000	10,000	30,000	30,000
sulfur (ppm)		1104	1325	1245	766	1444

Table S34. Microcut yields of the feedstocks for CDU₂ at the best solution to Example 3

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	3.68	4.55	4.97	4.78	6.76	3.50
90-110	2.04	2.63	2.88	2.82	3.53	2.35
110-130	2.23	1.24	1.38	2.73	2.78	2.30
130-140	1.35	1.23	1.36	1.31	1.22	1.30
140-150	0.99	2.33	2.58	1.01	0.85	1.28
150-170	2.59	3.31	3.64	2.71	2.50	2.50
170-190	2.71	2.34	2.54	2.38	2.07	2.40
190-210	2.12	2.34	2.52	2.50	2.00	2.30
210-230	3.45	2.61	2.79	2.61	2.37	2.80
230-250	3.29	3.92	4.22	3.78	3.47	3.50
250-275	4.79	3.18	3.30	4.43	4.04	4.30
275-300	4.45	4.21	4.35	5.21	4.55	4.50
300-325	5.15	4.50	4.58	4.89	5.08	5.10
325-350	4.69	4.06	4.02	4.36	4.70	4.90
350-400	4.43	4.41	4.47	5.31	5.27	5.90
400-450	14.28	10.22	10.28	10.62	10.50	12.00
450-500	10.48	8.64	8.31	8.85	8.71	9.40
>500	26.70	32.92	30.55	29.75	28.26	29.67

Table S35. TBP data of the feedstocks for CDU₂ at the best solution to Example 3

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	3.68	4.55	4.97	4.78	6.76	3.50
110	5.72	7.18	7.84	7.60	10.29	5.85
130	7.95	8.43	9.22	10.33	13.07	8.15
140	9.30	9.66	10.58	11.64	14.29	9.45
150	10.29	11.99	13.17	12.65	15.14	10.73
170	12.88	15.30	16.81	15.36	17.64	13.23
190	15.59	17.64	19.35	17.74	19.71	15.63
210	17.71	19.98	21.87	20.25	21.71	17.93
230	21.16	22.59	24.66	22.86	24.09	20.73
250	24.45	26.51	28.87	26.64	27.56	24.23
275	29.24	29.69	32.17	31.07	31.59	28.53
300	33.69	33.89	36.52	36.28	36.15	33.03
325	38.83	38.39	41.11	41.17	41.23	38.13
350	43.53	42.45	45.13	45.53	45.93	43.03
400	47.96	46.87	49.60	50.84	51.20	48.93
450	62.24	57.09	59.88	61.46	61.70	60.93
500	72.71	65.73	68.19	70.31	70.41	70.33

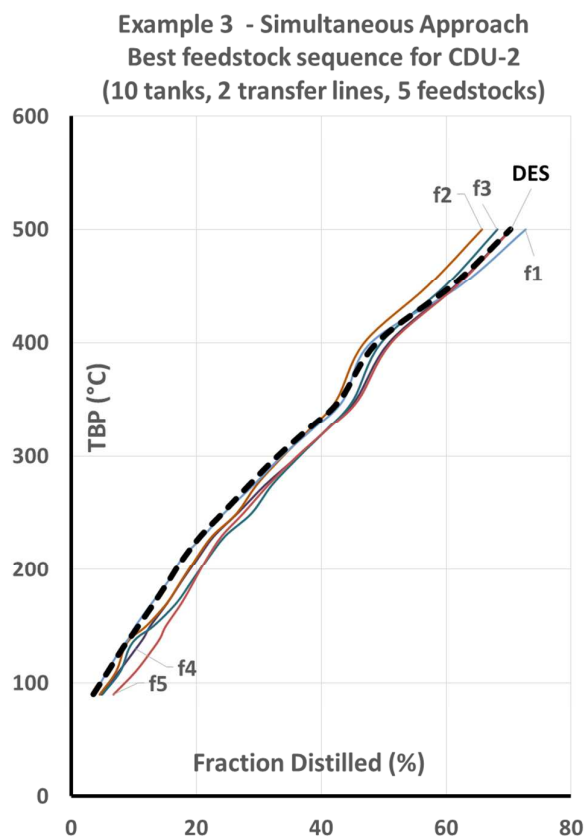


Figure S11. Best solution for CDU₂ at Example 3 using the simultaneous approach

I.8 Detailed computational results for Example 3 using the sequential approach

Table S36. MCOBS schedule for CDU₁ at the best solution to Example 3 using 7 time slots

		Best feedstock sequence for CDU ₁						
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇
start time (day)		0	2.75	4.58	7.59	10.70	13.75	16.48
end time (day)		2.75	4.58	7.59	10.70	13.75	16.48	20.42
added tank in	p ₁	tk ₁₃	tk ₁₈	tk ₁₇	-	-	tk ₁₂	tk ₃
	p ₂	tk ₁₀	-	tk ₁₅	tk ₄	tk ₁₁	tk ₈	-
tank sequence in	p ₁	tk ₁₃	tk ₁₈	tk ₁₇	tk ₁₇	tk ₁₇	tk ₁₂	tk ₃
	p ₂	tk ₁₀	tk ₁₀	tk ₁₅	tk ₄	tk ₁₁	tk ₈	tk ₈
emptied tank in	p ₁	tk ₁₃	tk ₁₈	-	-	tk ₁₇	tk ₁₂	tk ₃
	p ₂	-	tk ₁₀	tk ₁₅	tk ₄	tk ₁₁	-	tk ₈
crude oil in	p ₁	cr ₁	cr ₁	cr ₂	cr ₂	cr ₂	cr ₃	cr ₃
	p ₂	cr ₆	cr ₆	cr ₄	cr ₄	cr ₄	cr ₅	cr ₅
flow rate in	p ₁	227.3	227.3	223.0	231.7	227.0	305.3	317.5
(m ³ /h)	p ₂	272.7	272.7	277.0	268.3	273.0	194.7	182.5
batch size	p ₁	15,000	10,000	16,098	17,271	16,631	20,000	30,000
(m ³)	p ₂	18,000	12,000	20,000	20,000	20,000	12,759	17,241
sulfur (ppm)		991	991	925	930	927	1312	1283

Table S37. Microcut yields of the feedstocks for CDU₁ at the best solution to Example 3

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)							Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	
HK-90	3.95	3.95	5.10	5.27	5.18	4.62	4.77	3.50
90-110	2.57	2.57	2.57	2.66	2.62	2.67	2.76	2.35
110-130	2.60	2.60	2.55	2.61	2.58	1.26	1.31	2.30
130-140	1.36	1.36	1.37	1.39	1.38	1.25	1.30	1.30
140-150	1.14	1.14	0.90	0.91	0.90	2.37	2.46	1.28
150-170	2.65	2.65	2.77	2.81	2.79	3.36	3.49	2.50
170-190	2.82	2.82	2.37	2.39	2.38	2.37	2.45	2.40
190-210	2.45	2.45	2.21	2.22	2.21	2.37	2.43	2.30
210-230	3.37	3.37	2.80	2.82	2.81	2.63	2.70	2.80
230-250	3.21	3.21	3.94	3.97	3.95	3.96	4.07	3.50
250-275	4.36	4.36	4.93	4.94	4.94	3.20	3.24	4.30
275-300	4.86	4.86	4.82	4.85	4.84	4.23	4.28	4.50
300-325	4.60	4.60	5.52	5.53	5.53	4.51	4.54	5.10
325-350	4.43	4.43	4.67	4.67	4.67	4.06	4.04	4.90
350-400	4.56	4.56	5.23	5.26	5.25	4.42	4.44	5.90
400-450	10.49	10.49	14.33	14.23	14.28	10.23	10.25	12.00
450-500	8.83	8.83	10.23	10.13	10.18	8.59	8.47	9.40
>500	31.70	31.70	23.07	22.75	22.92	32.55	31.68	29.67

Table S38. TBP data of the feedstocks for CDU₁ at the best solution to Example 3

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)							$cydref_{mc}$
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	
90	3.95	3.95	5.10	5.27	5.18	4.62	4.77	3.50
110	6.53	6.53	7.68	7.93	7.80	7.29	7.53	5.85
130	9.13	9.13	10.23	10.54	10.38	8.55	8.84	8.15
140	10.49	10.49	11.60	11.93	11.75	9.80	10.14	9.45
150	11.64	11.64	12.50	12.84	12.66	12.17	12.61	10.73
170	14.29	14.29	15.28	15.65	15.45	15.54	16.09	13.23
190	17.11	17.11	17.65	18.04	17.83	17.91	18.54	15.63
210	19.56	19.56	19.85	20.27	20.04	20.28	20.97	17.93
230	22.93	22.93	22.66	23.08	22.85	22.91	23.67	20.73
250	26.13	26.13	26.60	27.05	26.81	26.88	27.75	24.23
275	30.50	30.50	31.53	31.99	31.75	30.08	30.99	28.53
300	35.36	35.36	36.36	36.84	36.58	34.31	35.28	33.03
325	39.96	39.96	41.88	42.38	42.11	38.82	39.82	38.13
350	44.39	44.39	46.55	47.05	46.78	42.88	43.86	43.03
400	48.95	48.95	51.78	52.31	52.03	47.30	48.30	48.93
450	59.44	59.44	66.12	66.54	66.31	57.53	58.56	60.93
500	68.27	68.27	76.35	76.67	76.50	66.12	67.02	70.33

Example 3 - Sequential Approach
TBP curves of the feedstocks for CDU-1
10 charging tanks, 7 feedstocks

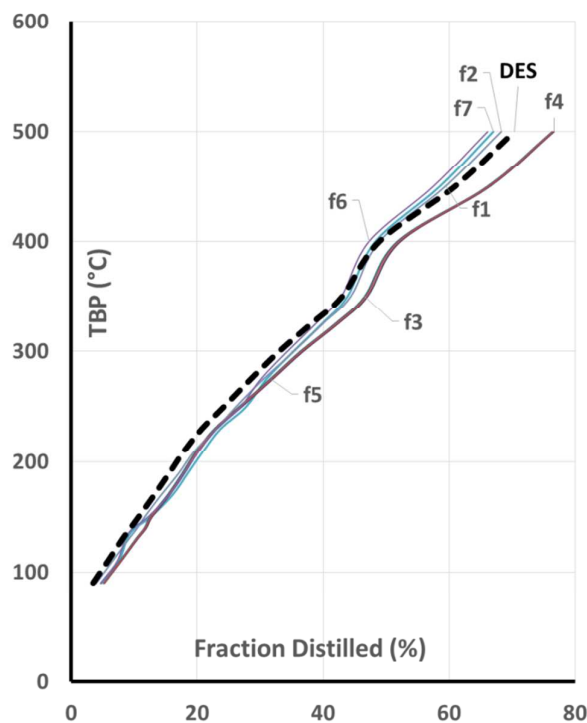


Figure S12. Best solution for CDU₁ at Example 3 using the sequential approach

Table S39. MCOBS schedule for CDU₂ at the best solution to Example 3 using 5 time slots

		Best feedstock sequence for CDU ₂				
		f ₁	f ₂	f ₃	f ₄	f ₅
start time (day)		0	2.50	8.33	11.25	15.42
end time (day)		2.50	8.33	11.25	15.42	19.58
added tank in	p ₁	tk ₂	tk ₉	tk ₁	tk ₇	tk ₁₄
	p ₂	tk ₅	tk ₂₀	tk ₁₉	tk ₆	tk ₁₆
tank sequence in	p ₁	tk ₂	tk ₉	tk ₁	tk ₇	tk ₁₄
	p ₂	tk ₅	tk ₂₀	tk ₁₉	tk ₆	tk ₁₆
emptied tank in	p ₁	tk ₂	tk ₉	tk ₁	tk ₇	tk ₁₄
	p ₂	tk ₅	tk ₂₀	tk ₁₉	tk ₆	tk ₁₆
crude oil in	p ₁	cr ₂	cr ₂	cr ₁	cr ₁	cr ₃
	p ₂	cr ₅	cr ₄	cr ₆	cr ₆	cr ₅
flow rate in	p ₁	333.3	214.3	214.3	200.0	300.0
(m ³ /h)	p ₂	166.7	285.7	285.7	300.0	200.0
batch size	p ₁	20,000	30,000	15,000	20,000	30,000
(m ³)	p ₂	10,000	40,000	20,000	30,000	20,000
sulfur (ppm)		1405	920	966	938	1325

Table S40. Microcut yields of the feedstocks for CDU₂ at the best solution to Example 3

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)					Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	
HK-90	7.16	4.94	3.79	3.61	4.55	3.50
90-110	3.74	2.49	2.49	2.40	2.63	2.35
110-130	2.96	2.49	2.55	2.49	1.24	2.30
130-140	1.30	1.35	1.34	1.31	1.23	1.30
140-150	0.90	0.89	1.13	1.10	2.33	1.28
150-170	2.64	2.74	2.62	2.57	3.31	2.50
170-190	2.17	2.35	2.77	2.72	2.34	2.40
190-210	2.08	2.19	2.44	2.44	2.34	2.30
210-230	2.47	2.79	3.30	3.23	2.61	2.80
230-250	3.62	3.91	3.20	3.19	3.92	3.50
250-275	4.17	4.93	4.34	4.31	3.18	4.30
275-300	4.66	4.80	4.87	4.88	4.21	4.50
300-325	5.17	5.51	4.58	4.55	4.50	5.10
325-350	4.72	4.66	4.41	4.39	4.06	4.90
350-400	5.37	5.21	4.57	4.59	4.41	5.90
400-450	10.56	14.44	10.48	10.47	10.22	12.00
450-500	8.51	10.33	8.90	8.99	8.64	9.40
>500	26.53	23.40	32.24	32.83	32.92	29.67

Table S41. TBP data of the feedstocks for CDU₂ at the best solution to Example 3

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)					<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	
90	7.16	4.94	3.79	3.61	4.55	3.50
110	10.90	7.43	6.28	6.00	7.18	5.85
130	13.96	9.92	8.83	8.49	8.43	8.15
140	15.16	11.27	10.16	9.80	9.66	9.45
150	16.06	12.16	11.29	10.90	11.99	10.73
170	18.70	14.90	13.90	13.47	15.30	13.23
190	20.88	17.25	16.67	16.19	17.64	15.63
210	22.96	19.44	19.11	18.63	19.98	17.93
230	25.43	22.23	22.42	21.85	22.59	20.73
250	29.05	26.15	25.62	25.05	26.51	24.23
275	33.21	31.07	29.95	29.36	29.69	28.53
300	37.88	35.88	34.82	32.24	33.89	33.03
325	43.05	41.39	39.40	38.79	38.39	38.13
350	47.77	46.05	43.81	43.17	42.45	43.03
400	53.13	51.26	48.39	47.76	46.87	48.93
450	63.69	65.69	58.86	58.23	57.09	60.93
500	72.20	76.03	67.77	67.22	65.73	70.33

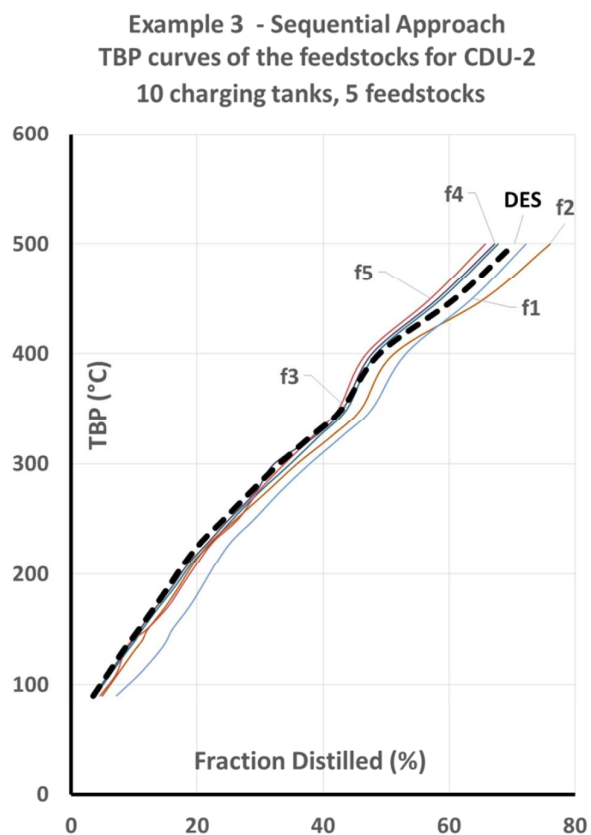


Figure S13. Best solution for CDU₂ at Example 3 using the sequential approach

II. SOLVING LARGER PROBLEMS WITH THE SEQUENTIAL APPROACH

II.1 Data for Examples 4-12

Table S42. Problem data for Examples 4-7

Tank	Crude oil Stored	Amount (m ³)	Sulfur concentration (ppm)	Emptying due date (day)
tk ₁	cr ₁	10000	430	10
tk ₂	cr ₁	10000	430	30
tk ₃	cr ₁	10000	430	30
tk ₄	cr ₁	15000	430	30
tk ₅	cr ₂	10000	1518	30
tk ₆	cr ₂	10000	1518	30
tk ₇	cr ₃	10000	794	20
tk ₈	cr ₃	10000	794	20
tk ₉	cr ₄	20000	2833	20
tk ₁₀	cr ₄	10000	2833	30
tk ₁₁	cr ₄	25000	2833	30
tk ₁₂	cr ₅	20000	3960	10
tk ₁₃	cr ₅	10000	3960	30
tk ₁₄	cr ₆	30000	2040	30
tk ₁₅	cr ₇	15000	1087	10
tk ₁₆	cr ₇	50000	1087	10
tk ₁₇	cr ₈	20000	848	30
tk ₁₈	cr ₈	20000	848	30
tk ₁₉	cr ₈	10000	848	30
tk ₂₀	cr ₄	10000	2833	30
tk ₂₁	cr ₄	20000	2833	30
tk ₂₂	cr ₄	10000	2833	30
tk ₂₃	cr ₄	20000	2833	30
tk ₂₄	cr ₉	20000	552	30
tk ₂₅	cr ₉	50000	552	30
tk ₂₆	cr ₃	20000	794	30
tk ₂₇	cr ₃	10000	794	30
tk ₂₈	cr ₆	10000	2040	20
tk ₂₉	cr ₆	50000	2040	20
tk ₃₀	cr ₆	20000	2040	20

Additional data:

Tank unloading flow rate (min-max): 100-400 (m³/h)

Feed flow rate to the CDU : 500 (m³/h)

Maximum sulfur concentration in the feedstock: 2500 ppm

Table S43. Microcut yields of crude oils available for Examples 4-9

Boiling range (°C)	Normalized weight	Yield of each microcut in the available crude oils (%)								
		cr ₁	cr ₂	cr ₃	cr ₄	cr ₅	cr ₆	cr ₇	cr ₈	cr ₉
HK-90	0.1029	2.34	7.40	0.89	4.06	2.88	0.80	10.34	7.05	1.08
90-110	0.1029	1.57	4.34	0.31	3.78	2.83	0.43	5.39	4.10	1.10
110-130	0.1029	2.50	3.80	1.05	3.87	2.37	0.05	4.42	2.04	1.61
130-140	0.1029	1.51	1.93	0.92	1.86	1.65	0.03	1.93	2.03	0.89
140-150	0.1029	1.16	1.56	0.56	1.92	1.28	0.07	1.32	3.84	0.80
150-170	0.1029	2.56	3.45	1.93	3.08	2.45	0.33	3.80	5.30	1.99
170-190	0.0618	2.45	3.82	1.88	3.19	2.63	0.56	2.98	3.53	1.98
190-210	0.0618	2.20	2.58	1.77	3.14	2.67	0.75	2.78	3.40	2.34
210-230	0.0618	2.34	4.77	2.46	3.46	3.15	0.95	3.23	3.71	2.20
230-250	0.0618	3.28	3.35	3.24	4.06	3.16	1.23	4.81	5.71	3.09
250-275	0.0618	4.74	4.88	4.73	4.24	7.57	2.12	5.19	3.89	3.93
275-300	0.0206	4.66	4.71	4.25	3.35	6.27	2.91	5.54	5.07	4.99
300-325	0.0206	4.34	5.05	5.22	5.32	4.26	3.71	5.90	5.02	4.22
325-350	0.0206	4.54	4.92	4.52	5.59	8.52	4.46	4.85	3.80	4.03
350-400	0.0041	6.85	4.30	4.53	8.08	12.32	3.88	6.11	4.77	4.78
400-450	0.0041	13.99	10.65	17.00	9.93	12.03	9.63	11.02	10.61	10.35
450-500	0.0041	9.43	7.27	12.88	7.78	7.65	11.65	6.94	6.64	10.13
>500	0.0000	28.59	20.38	31.44	23.36	15.57	54.22	12.68	18.72	41.13

TBP curves of the available crude oils for Examples 4-9

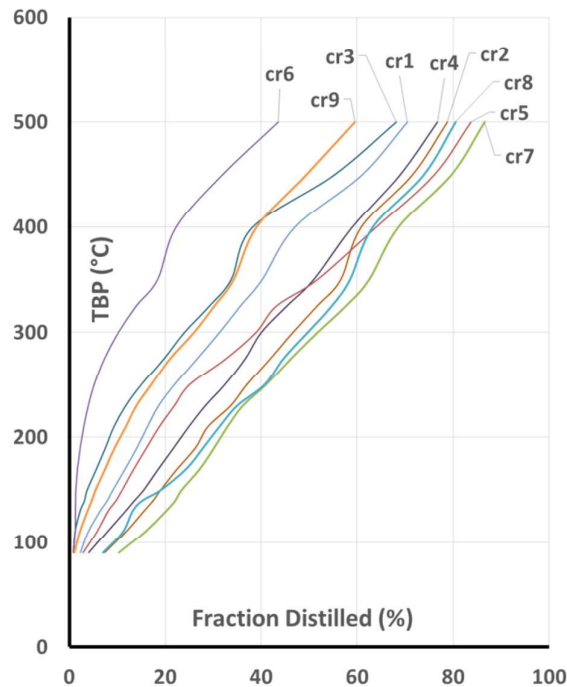


Figure S14. TBP curves for the available crude oils at Examples 4-9

Table S44. Additional problem data for Examples 8-12

Tank	Crude oil Stored	Amount (m ³)	Sulfur concentration (ppm)	Emptying due date (day)
tk ₃₁	cr ₁	10000	430	15
tk ₃₂	cr ₁	20000	430	30
tk ₃₃	cr ₂	30000	1518	30
tk ₃₄	cr ₂	30000	1518	30
tk ₃₅	cr ₃	20000	794	20
tk ₃₆	cr ₄	20000	2833	20
tk ₃₇	cr ₅	10000	3960	13
tk ₃₈	cr ₆	20000	2040	30
tk ₃₉	cr ₆	20000	2040	30
tk ₄₀	cr ₇	20000	1087	10
tk ₄₁	cr ₈	20000	848	30
tk ₄₂	cr ₈	20000	848	30
tk ₄₃	cr ₉	30000	552	30
tk ₄₄	cr ₃	20000	794	30
tk ₄₅	cr ₃	30000	794	30
tk ₄₆	cr ₁₀	20000	2650	30
tk ₄₇	cr ₁₀	30000	2650	10
tk ₄₈	cr ₁₁	10000	2100	15
tk ₄₉	cr ₁₁	20000	2100	30
tk ₅₀	cr ₁₁	50000	2100	30
tk ₅₁	cr ₁₂	10000	880	20
tk ₅₂	cr ₁₂	15000	880	25
tk ₅₃	cr ₁₂	20000	880	30
tk ₅₄	cr ₁₂	30000	880	30
tk ₅₅	cr ₁₃	10000	1800	10
tk ₅₆	cr ₁₃	30000	1800	30
tk ₅₇	cr ₁₃	20000	1800	30
tk ₅₈	cr ₁₄	20000	2300	10
tk ₅₉	cr ₁₄	10000	2300	30
tk ₆₀	cr ₁₄	40000	2300	30

Additional data:Tank unloading flow rate (min-max): 100-400 (m³/h)Feed flow rate to the CDU : 500 (m³/h)

Maximum sulfur concentration in the feedstock: 2500 ppm

Table S45. New available crude oils and their microcut yields for Examples 10-12

Boiling range (°C)	Normalized weight	Yield of each microcut in the new available crude oils (%)				
		cr ₁₀	cr ₁₁	cr ₁₂	cr ₁₃	cr ₁₄
HK-90	0.1029	4.25	0.85	1.71	5.82	3.30
90-110	0.1029	2.95	0.37	1.54	3.65	2.26
110-130	0.1029	3.15	0.55	2.05	3.47	2.83
130-140	0.1029	1.72	0.48	1.20	1.83	1.61
140-150	0.1029	1.36	0.32	0.98	1.46	1.26
150-170	0.1029	3.00	1.13	2.28	3.23	2.78
170-190	0.0618	3.13	1.22	2.22	3.48	2.79
190-210	0.0618	2.39	1.26	2.27	2.48	2.30
210-230	0.0618	3.55	1.71	2.27	4.16	2.45
230-250	0.0618	3.31	2.24	3.19	3.33	3.29
250-275	0.0618	4.81	3.42	4.33	4.85	4.78
275-300	0.0206	4.68	3.58	4.83	4.69	4.67
300-325	0.0206	4.69	4.47	4.28	4.87	4.51
325-350	0.0206	4.73	4.49	4.29	4.83	4.64
350-400	0.0041	5.57	4.21	5.82	4.93	6.21
400-450	0.0041	12.32	13.31	12.17	11.48	13.16
450-500	0.0041	8.35	12.27	9.78	7.81	8.89
>500	0.0000	24.48	42.83	34.86	22.43	26.53

Table S46. Desired microcut yields of the feedstocks for Examples 4-12

Example 4	Example 5	Example 6	Example 7		Example 8	Example 9	Example 10	Example 11	Example 12
CDUs 1-2	CDUs 1-2	CDUs 1-2	CDU ₁	CDU ₂	CDUs 1-3	CDUs 1-3	CDUs 1-4	CDUs 1-4	CDUs 1-4
3.50	2.35	3.56	2.35	3.50	3.63	2.35	3.47	3.55	2.35
2.35	1.83	2.36	1.83	2.35	2.35	1.83	2.26	2.36	1.83
2.30	2.50	2.29	2.50	2.30	2.25	2.50	2.26	2.29	2.50
1.30	1.01	1.30	1.01	1.30	1.30	1.01	1.31	1.30	1.01
1.28	1.36	1.25	1.36	1.28	1.26	1.36	1.20	1.25	1.36
2.50	2.72	2.53	2.72	2.50	2.56	2.72	2.52	2.53	2.72
2.40	2.53	2.39	2.53	2.40	2.40	2.53	2.42	2.39	2.53
2.30	3.19	2.28	3.19	2.30	2.26	3.19	2.22	2.28	3.19
2.80	3.13	2.72	3.13	2.80	2.76	3.13	2.76	2.72	3.13
3.50	4.06	3.39	4.06	3.50	3.40	4.06	3.30	3.39	4.06
4.30	4.93	4.26	4.93	4.30	4.28	4.93	4.30	4.26	4.93
4.50	4.98	4.30	4.98	4.50	4.33	4.98	4.36	4.30	4.98
5.10	5.15	4.78	5.15	5.10	4.79	5.15	4.73	4.77	5.15
4.90	5.22	4.84	5.22	4.90	4.81	5.22	4.75	4.84	5.22
5.90	4.76	5.88	4.76	5.90	4.74	4.76	5.62	5.88	4.76
12.00	15.75	11.76	15.75	12.00	11.92	15.75	12.07	11.77	15.75
9.40	9.87	9.39	9.87	9.40	9.43	9.87	9.47	9.38	9.87
29.67	23.77	30.05	23.77	29.67	29.80	23.77	30.15	29.90	23.77

TBP curves of the available crude oils for Examples 10-12

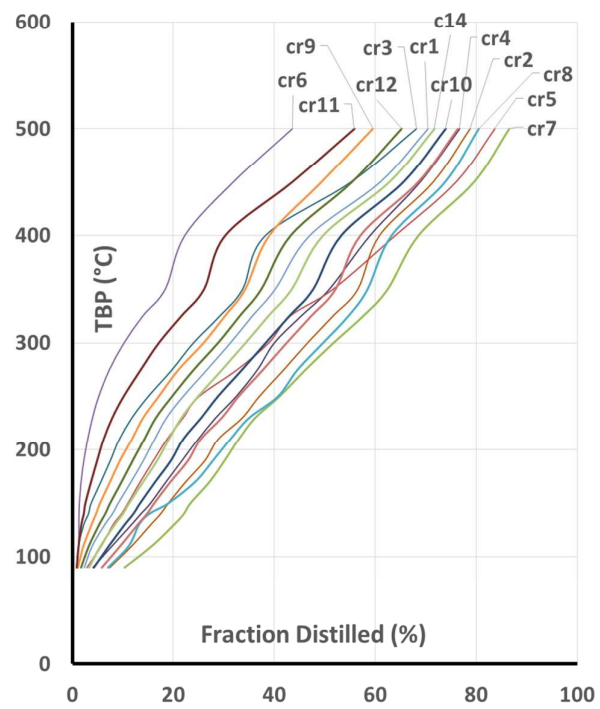


Figure S15. TBP curves of crude oils available for Examples 10-12

II.2 Computational results for Examples 4-12 using the sequential approach

Table S47. Best solutions and CPU times for Examples 4-12 using the sequential approach

Example	CDU	# transf. pipelines	# tanks	# slots	Best MILP-NLP solution	MILP model		NLP model
						CPU time (s)	Gap (%)	CPU time (s)
Example 4	CDU ₁	2	16	9	5.80	2345	-	0.34
	CDU ₂	2	14	8	4.47	247	-	0.41
Example 5	CDU ₁	2	15	8	5.12	290	-	0.33
	CDU ₂	2	15	8	9.81	199	-	0.30
Example 6	CDU ₁	2	16	9	8.54	2544	-	0.95
	CDU ₂	2	14	8	4.43	309	-	0.50
Example 7	CDU ₁	2	15	8	6.95	219	-	0.40
	CDU ₂	2	15	8	5.67	388	-	0.28
Example 8	CDU ₁	2	15	8	5.08	626	-	0.27
	CDU ₂	2	15	8	7.70	464	-	0.36
	CDU ₃	2	15	8	4.90	200	-	0.22
Example 9	CDU ₁	2	15	8	6.69	1839	-	0.25
	CDU ₂	2	15	8	7.89	384	-	0.50
	CDU ₃	2	15	8	6.90	2856	-	0.30
Example 10	CDU ₁	2	15	8	4.48	755	-	0.36
	CDU ₂	2	15	8	5.18	567	-	0.31
	CDU ₃	2	15	8	7.79	336	-	0.42
	CDU ₄	2	15	8	4.88	174	-	0.16
Example 11	CDU ₁	2	15	8	3.10	1831	-	0.37
	CDU ₂	2	16	9	6.46	520	-	0.92
	CDU ₃	2	15	9	6.46	558	-	0.75
	CDU ₄	2	14	8	3.54	1126	-	0.33
Example 12	CDU ₁	2	15	8	5.79	1222	-	0.33
	CDU ₂	2	15	8	7.47	127	-	0.42
	CDU ₃	2	15	8	3.02	1370	-	0.25
	CDU ₄	2	15	8	10.05	320	-	0.33

Table S48. Linear and quadratic deviations at the best solutions for Examples 4-12

Example	CDU	# tanks	# feedstocks	ldev ₁	ldev ₂	qdev ₁	qdev ₂	ldev ₁ + ldev ₂	qdev ₁ + qdev ₂
Example 4	CDU ₁	16	9	3.27	3.24	2.59	3.21	6.51	5.80
	CDU ₂	14	8	2.94	2.41	2.15	2.32	5.35	4.47
Example 5	CDU ₁	15	8	3.50	2.15	3.11	2.01	5.65	5.12
	CDU ₂	15	8	5.26	2.62	7.66	2.15	7.88	9.81
Example 6	CDU ₁	16	9	3.55	3.45	3.82	4.72	7.00	8.54
	CDU ₂	14	8	2.90	2.99	1.88	2.55	5.89	4.43
Example 7	CDU ₁	15	8	3.83	2.43	4.52	2.43	6.26	6.95
	CDU ₂	15	8	3.26	3.56	2.44	3.23	6.82	5.67
Example 8	CDU ₁	15	8	2.95	3.33	2.00	3.08	6.28	5.08
	CDU ₂	15	8	3.17	4.00	2.98	4.72	7.17	7.70
	CDU ₃	15	8	3.01	2.67	2.39	2.51	5.68	4.90
Example 9	CDU ₁	15	8	4.40	2.65	4.51	2.18	7.05	6.69
	CDU ₂	15	8	4.73	2.93	5.09	2.80	7.66	7.89
	CDU ₃	15	8	3.91	2.33	4.25	2.65	6.24	6.90
Example 10	CDU ₁	15	8	2.66	2.55	1.93	2.55	5.21	4.48
	CDU ₂	15	8	2.99	3.45	1.93	3.25	6.44	5.18
	CDU ₃	15	8	3.49	3.18	4.25	3.54	6.67	7.79
	CDU ₄	15	8	2.72	3.06	1.94	2.94	5.78	4.88
Example 11	CDU ₁	15	8	2.59	2.34	1.52	1.58	4.93	3.10
	CDU ₂	16	9	3.21	3.85	2.45	4.01	7.06	6.46
	CDU ₃	15	9	3.55	3.09	3.97	2.49	6.64	6.46
	CDU ₄	14	8	2.37	2.46	1.54	2.00	4.83	3.54
Example 12	CDU ₁	15	8	4.35	1.59	4.88	0.91	5.94	5.79
	CDU ₂	15	8	4.45	3.05	4.83	2.64	7.50	7.47
	CDU ₃	15	8	2.92	1.63	2.09	0.93	4.55	3.02
	CDU ₄	15	8	5.20	3.46	7.44	2.61	8.66	10.05

ldev = absolute linear deviation , qdev = quadratic deviation , ldev1,qdev1 = from the desired value , ldev2,qdev2 = in successive slots

II.3 Detailed results for Example 4 using the sequential approach

Table S49. MCOBS schedule for CDU₁ at the best solution to Example 4 using 9 time slots

		Best feedstock sequence for CDU ₁								
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉
start time (day)		0	2.50	5.42	7.08	10.00	12.87	15.75	19.17	25.83
end time (day)		2.50	5.42	7.08	10.00	12.87	15.75	19.17	25.83	29.17
added tank in	p ₁	tk ₅	tk ₁₅	tk ₂₀	tk ₁₂	tk ₂₃	tk ₂₁	tk ₁₈	tk ₆	tk ₁₉
	p ₂	tk ₂₈	tk ₂₆	tk ₂₇	tk ₁	tk ₂₉	-	-	tk ₂₅	tk ₃
tank sequence in	p ₁	tk ₅	tk ₁₅	tk ₂₀	tk ₁₂	tk ₂₃	tk ₂₁	tk ₁₈	tk ₆	tk ₁₉
	p ₂	tk ₂₈	tk ₂₆	tk ₂₇	tk ₁	tk ₂₉	tk ₂₉	tk ₂₉	tk ₂₅	tk ₃
emptied tank in	p ₁	tk ₅	tk ₁₅	tk ₂₀	tk ₁₂	tk ₂₃	tk ₂₁	tk ₁₈	tk ₆	tk ₁₉
	p ₂	tk ₂₈	tk ₂₆	tk ₂₇	tk ₁	-	-	tk ₂₉	tk ₂₅	tk ₃
crude oil in	p ₁	cr ₂	cr ₇	cr ₄	cr ₅	cr ₄	cr ₄	cr ₈	cr ₂	cr ₈
	p ₂	cr ₆	cr ₃	cr ₃	cr ₁	cr ₆	cr ₆	cr ₆	cr ₉	cr ₁
flow rate in	p ₁	333.3	214.3	250.0	285.7	290.0	290.0	243.6	187.5	125.0
(m ³ /h)	p ₂	166.7	285.7	250.0	214.3	210.0	210.0	256.4	312.5	375.0
batch size	p ₁	20,000	15,000	10,000	20,000	20,000	20,000	20,000	30,000	10,000
(m ³)	p ₂	10,000	20,000	10,000	15,000	14,478	14,478	21,043	50,000	30,000
sulfur (ppm)		1692	920	1814	2447	2500	2500	1459	914	535

Table S50. Microcut yields in the feedstock for CDU₁ at the best solution for Example 4

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)									Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
HK-90	5.20	4.94	2.61	2.47	2.69	2.69	3.85	3.45	3.52	3.50
90-110	3.04	2.49	2.20	2.04	2.37	2.37	2.22	2.31	2.20	2.35
110-130	2.55	2.49	2.43	2.46	2.27	2.27	1.02	2.43	2.38	2.30
130-140	1.30	1.35	1.58	1.39	1.09	1.09	1.00	1.28	1.64	1.30
140-150	1.06	0.89	1.22	1.24	1.14	1.14	1.91	1.08	1.83	1.28
150-170	2.41	2.73	2.50	2.51	1.92	1.92	2.75	2.54	3.24	2.50
170-190	2.73	2.35	2.54	2.53	2.09	2.09	2.01	2.67	2.72	2.40
190-210	1.97	2.19	2.43	2.45	2.14	2.14	2.04	2.43	2.50	2.30
210-230	3.50	2.79	2.74	2.96	2.41	2.41	2.29	3.16	2.68	2.80
230-250	2.64	3.91	3.22	3.65	2.87	2.87	3.41	3.19	3.89	3.50
250-275	3.96	4.93	6.15	4.48	3.35	3.35	2.98	4.29	4.53	4.30
275-300	4.11	4.80	5.46	3.80	3.16	3.16	3.96	4.88	4.76	4.50
300-325	4.60	5.51	4.30	5.27	4.64	4.64	4.35	4.53	4.51	5.10
325-350	4.77	4.66	6.53	5.05	5.11	5.11	4.14	4.36	4.35	4.90
350-400	4.16	5.21	9.58	6.30	6.32	6.32	4.31	4.60	6.33	5.90
400-450	10.31	14.44	13.01	13.46	9.80	9.80	10.11	10.46	13.14	12.00
450-500	8.73	10.33	8.54	10.33	9.40	9.40	9.21	9.06	8.73	9.40
>500	31.66	23.40	22.08	27.40	36.32	36.32	36.92	33.35	26.12	29.67

Table S51. TBP data of the feedstocks for CDU₁ at the best solution to Example 4

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)									<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
90	5.20	4.94	2.61	2.47	2.69	2.69	3.85	3.45	3.52	3.50
110	8.24	7.43	4.81	4.52	5.06	5.06	6.06	5.76	5.72	5.85
130	10.79	9.92	7.24	6.98	7.33	7.33	7.08	8.19	8.10	8.15
140	12.08	11.27	8.82	8.37	8.42	8.42	8.09	9.48	9.74	9.45
150	13.15	12.16	10.04	9.61	9.56	9.56	9.99	10.56	11.57	10.73
170	15.56	14.89	12.55	12.12	11.49	11.49	12.75	13.10	14.82	13.23
190	18.29	17.25	15.09	14.66	13.58	13.58	14.75	15.77	17.54	15.63
210	20.26	19.44	17.52	17.11	15.71	15.71	16.80	18.20	20.04	17.93
230	23.76	22.23	20.27	20.07	18.12	18.12	19.09	21.36	22.72	20.73
250	26.40	26.15	23.49	23.72	20.99	20.99	22.50	24.55	26.61	24.23
275	30.36	31.07	29.64	28.21	24.34	24.34	25.49	28.84	31.14	28.53
300	34.47	35.88	35.11	32.01	27.50	27.50	29.45	33.72	35.90	33.03
325	39.07	41.39	39.41	37.28	32.15	32.15	33.80	38.25	40.41	38.13
350	43.84	46.05	45.94	42.33	37.26	37.26	37.93	42.62	44.76	43.03
400	48.00	51.26	55.52	48.64	43.58	43.58	42.25	47.22	51.09	48.93
450	58.31	65.69	68.53	62.10	53.38	53.38	52.36	57.68	64.24	60.93
500	67.04	76.03	77.07	72.43	62.79	62.79	61.56	66.74	72.97	70.33

Example 4 - Sequential Approach
TBP curves of the feedstocks for CDU-1
16 charging tanks, 9 feedstocks

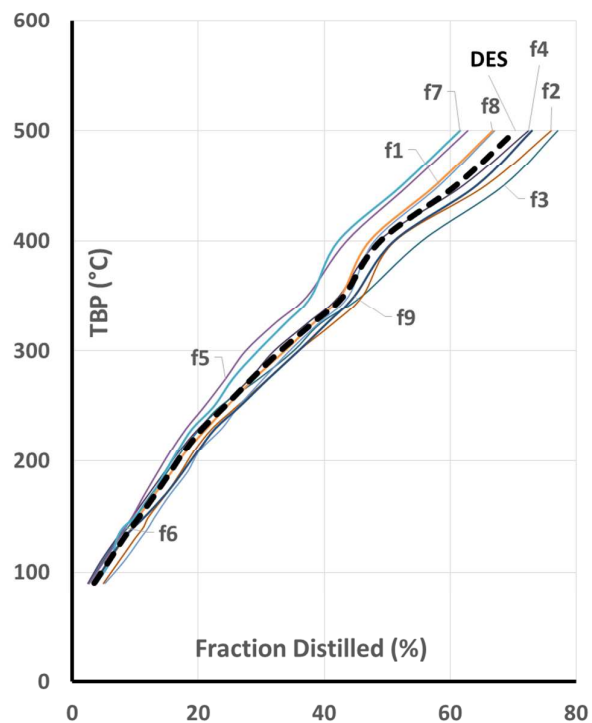


Figure S16. TBP curves of the feedstocks for CDU₁ at the best solution for Example 4

Table S52. MCOBS schedule for CDU₂ at the best solution to Example 4 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	7.36	10.00	13.33	17.73	19.17	21.25	23.75
end time (day)		7.36	10.00	13.33	17.73	19.17	21.25	23.75	27.50
added tank in	p ₁	tk ₁₆	-	tk ₁₇	tk ₉	tk ₂₂	tk ₁₃	tk ₁₀	tk ₁₁
	p ₂	tk ₇	tk ₈	tk ₃₀	tk ₁₄	-	tk ₄	tk ₂	tk ₂₄
tank sequence in	p ₁	tk ₁₆	tk ₁₆	tk ₁₇	tk ₉	tk ₂₂	tk ₁₃	tk ₁₀	tk ₁₁
	p ₂	tk ₇	tk ₈	tk ₃₀	tk ₁₄	tk ₁₄	tk ₄	tk ₂	tk ₂₄
emptied tank in	p ₁	-	tk ₁₆	tk ₁₇	tk ₉	tk ₂₂	tk ₁₃	tk ₁₀	tk ₁₁
	p ₂	tk ₇	tk ₈	tk ₃₀	-	tk ₁₄	tk ₄	tk ₂	tk ₂₄
crude oil in	p ₁	cr ₇	cr ₇	cr ₈	cr ₄	cr ₄	cr ₅	cr ₄	cr ₄
	p ₂	cr ₃	cr ₃	cr ₆	cr ₆	cr ₆	cr ₁	cr ₁	cr ₉
flow rate in	p ₁	217.0	184.0	250.0	284.3	290.0	200.0	166.7	277.8
(m ³ /h)	p ₂	283.0	316.0	250.0	215.7	210.0	300.0	333.3	222.2
batch size	p ₁	38,358	11,642	20,000	30,000	10,000	10,000	10,000	25,000
(m ³)	p ₂	50,000	20,000	20,000	22,761	7,239	15,000	20,000	20,000
sulfur (ppm)		921	902	1444	2491	2500	1842	1231	1819

Table S53. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 4

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.99	4.37	3.92	2.65	2.69	2.56	2.91	2.74	3.50
90-110	2.51	2.18	2.26	2.33	2.37	2.07	2.31	2.59	2.35
110-130	2.51	2.29	1.04	2.22	2.27	2.45	2.96	2.87	2.30
130-140	1.36	1.29	1.03	1.07	1.09	1.57	1.63	1.43	1.30
140-150	0.89	0.84	1.95	1.12	1.14	1.21	1.41	1.42	1.28
150-170	2.74	2.62	2.81	1.89	1.92	2.52	2.73	2.60	2.50
170-190	2.36	2.28	2.04	2.05	2.09	2.52	2.70	2.65	2.40
190-210	2.19	2.13	2.07	2.11	2.14	2.39	2.51	2.78	2.30
210-230	2.79	2.74	2.33	2.38	2.41	2.66	2.71	2.90	2.80
230-250	3.92	3.82	3.47	2.84	2.87	3.23	3.54	3.63	3.50
250-275	4.93	4.90	3.00	3.32	3.35	5.87	4.57	4.10	4.30
275-300	4.81	4.72	3.99	3.16	3.16	5.30	4.22	4.08	4.50
300-325	5.51	5.47	4.36	4.62	4.64	4.31	4.67	4.83	5.10
325-350	4.66	4.64	4.13	5.10	5.11	6.13	4.89	4.90	4.90
350-400	5.22	5.11	4.32	6.27	6.32	9.04	7.26	6.61	5.90
400-450	14.40	14.80	10.12	9.89	9.80	13.21	12.64	10.12	12.00
450-500	10.30	10.69	9.14	9.45	9.40	8.72	8.88	8.82	9.40
>500	23.30	24.54	36.47	36.67	36.32	23.38	26.85	31.26	29.67

Table S54. TBP data of the feedstocks for CDU₂ at the best solution to Example 4

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.99	4.37	3.92	2.65	2.69	2.56	2.91	2.74	3.50
110	7.51	6.55	6.19	4.99	5.06	4.63	5.22	5.32	5.85
130	10.02	8.84	7.23	7.21	7.33	7.08	8.18	8.19	8.15
140	11.38	10.13	8.26	8.28	8.42	8.64	9.80	9.62	9.45
150	12.27	10.97	10.22	9.40	9.56	9.85	11.22	11.04	10.73
170	15.01	13.58	13.03	11.30	11.49	12.37	13.95	13.64	13.23
190	17.37	15.87	15.08	13.35	13.58	14.89	16.65	16.29	15.63
210	19.56	18.00	17.15	15.46	15.71	17.28	19.16	19.07	17.93
230	22.36	20.74	19.48	17.84	18.12	19.94	21.87	21.97	20.73
250	26.28	24.56	22.95	20.68	20.99	23.17	25.41	25.60	24.23
275	31.21	29.46	25.96	24.00	24.34	29.05	29.99	29.70	28.53
300	36.02	34.18	29.95	27.16	27.50	34.35	34.21	33.78	33.03
325	41.53	39.65	34.31	31.79	32.15	38.66	38.88	38.61	38.13
350	46.20	44.30	38.44	36.89	37.26	44.79	43.77	43.51	43.03
400	51.41	49.41	42.77	43.16	43.58	53.83	51.03	50.12	48.93
450	65.82	64.21	52.89	52.96	53.38	67.03	63.66	60.24	60.93
500	76.12	74.90	62.03	62.41	62.79	75.75	72.54	69.07	70.33

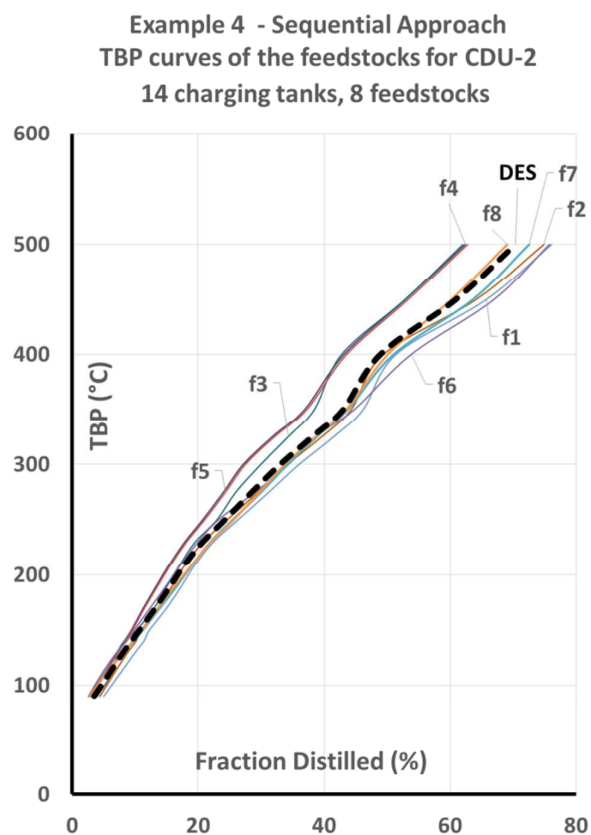


Figure S17. TBP curves of the feedstocks for CDU₂ at the best solution to Example 4

II.4 Detailed results for Example 5 using the sequential approach

Table S55. MCOBS schedule for CDU₁ at the best solution to Example 5 using 8 time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	5.00	8.33	14.05	15.83	19.58	22.92	25.00
end time (day)		5.00	8.33	14.05	15.83	19.58	22.92	25.00	28.33
added tank in	p ₁	tk ₆	tk ₁	tk ₉	tk ₂₀	tk ₁₁	tk ₂₂	tk ₁₀	tk ₅
	p ₂	tk ₁₄	tk ₁₂	tk ₇	-	tk ₈	tk ₃	tk ₄	tk ₂₆
tank sequence in	p ₁	tk ₆	tk ₁	tk ₉	tk ₂₀	tk ₁₁	tk ₂₂	tk ₁₀	tk ₅
	p ₂	tk ₁₄	tk ₁₂	tk ₇	tk ₇	tk ₈	tk ₃	tk ₄	tk ₂₆
emptied tank in	p ₁	tk ₆	tk ₁	tk ₉	tk ₂₀	tk ₁₁	tk ₂₂	tk ₁₀	tk ₅
	p ₂	tk ₁₄	tk ₁₂	-	tk ₇	tk ₈	tk ₃	tk ₄	tk ₂₆
crude oil in	p ₁	cr ₂	cr ₁	cr ₄	cr ₄	cr ₄	cr ₄	cr ₄	cr ₂
	p ₂	cr ₆	cr ₅	cr ₃	cr ₃	cr ₃	cr ₁	cr ₁	cr ₃
flow rate in	p ₁	250.0	250.0	218.5	234.0	277.8	125.0	200.0	250.0
(m ³ /h)	p ₂	250.0	250.0	281.5	266.0	222.2	375.0	300.0	250.0
batch size	p ₁	30,000	20,000	30,000	10,000	25,000	10,000	10,000	20,000
(m ³)	p ₂	30,000	20,000	38,633	11,367	20,000	30,000	15,000	20,000
sulfur (ppm)		1779	2195	1685	1748	1927	1031	1391	1156

Table S56. Microcut yields in the feedstocks for CDU₁ at the best solution to Example 5

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.10	2.61	2.28	2.37	2.65	2.77	3.03	4.14	2.35
90-110	2.38	2.20	1.83	1.93	2.24	2.12	2.45	2.32	1.83
110-130	1.92	2.43	2.28	2.37	2.62	2.84	3.05	2.42	2.50
130-140	0.98	1.58	1.33	1.36	1.44	1.60	1.65	1.42	1.01
140-150	0.81	1.22	1.15	1.20	1.32	1.35	1.46	1.06	1.36
150-170	1.89	2.50	2.44	2.48	2.58	2.69	2.77	2.70	2.72
170-190	2.19	2.54	2.45	2.49	2.61	2.63	2.75	2.85	2.53
190-210	1.66	2.43	2.37	2.41	2.53	2.43	2.58	2.17	3.19
210-230	2.86	2.74	2.90	2.93	3.01	2.62	2.79	3.61	3.13
230-250	2.29	3.22	3.60	3.62	3.70	3.47	3.59	3.29	4.06
250-275	3.50	6.15	4.52	4.50	4.46	4.61	4.54	4.80	4.93
275-300	3.81	5.46	3.86	3.83	3.75	4.33	4.14	4.48	4.98
300-325	4.38	4.30	5.26	5.27	5.28	4.58	4.73	5.13	5.15
325-350	4.69	6.53	4.99	5.02	5.11	4.80	4.96	4.72	5.22
350-400	4.09	9.58	6.08	6.19	6.50	7.16	7.34	4.41	4.76
400-450	10.14	13.01	13.91	13.69	13.07	12.97	12.37	13.82	15.75
450-500	9.46	8.54	10.65	10.49	10.05	9.11	8.77	10.07	9.87
>500	37.30	22.08	27.91	27.66	26.95	27.28	26.50	25.91	23.77

Table S57. TBP data of the feedstocks for CDU₁ at the best solution to Example 5

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.10	2.61	2.28	2.37	2.65	2.77	3.03	4.14	2.35
110	6.48	4.81	4.10	4.31	4.89	4.89	5.48	6.47	4.18
130	8.41	7.24	6.38	6.68	7.51	7.73	8.53	8.89	6.68
140	9.39	8.82	7.72	8.04	8.94	9.33	10.18	10.32	7.69
150	10.20	10.04	8.87	9.23	10.26	10.68	11.64	11.38	9.05
170	12.09	12.55	11.31	11.71	12.84	13.37	14.41	14.08	11.77
190	14.28	15.09	13.77	14.21	15.45	16.01	17.16	16.93	14.30
210	15.95	17.52	16.14	16.62	17.98	18.44	19.73	19.10	17.49
230	18.81	20.27	19.03	19.54	21.00	21.06	22.52	22.72	20.62
250	21.10	23.49	22.63	23.17	24.69	24.54	26.11	26.01	24.68
275	24.60	29.64	27.15	27.67	29.15	29.15	30.65	30.82	29.61
300	28.41	35.11	31.00	31.50	32.90	33.48	34.79	35.30	34.59
325	32.79	39.41	36.27	36.76	28.17	38.07	39.52	40.43	39.74
350	37.48	45.94	41.25	41.79	43.29	42.87	44.48	45.15	44.96
400	41.57	55.52	47.34	47.98	49.79	50.03	51.82	49.57	49.72
450	51.71	68.53	61.25	61.67	62.86	63.00	64.19	63.39	65.47
500	61.17	77.07	71.90	72.16	72.91	72.02	72.96	73.47	75.34

Example 5 - Sequential Approach
TBP curves of the feedstocks for CDU-1
15 charging tanks, 8 feedstocks

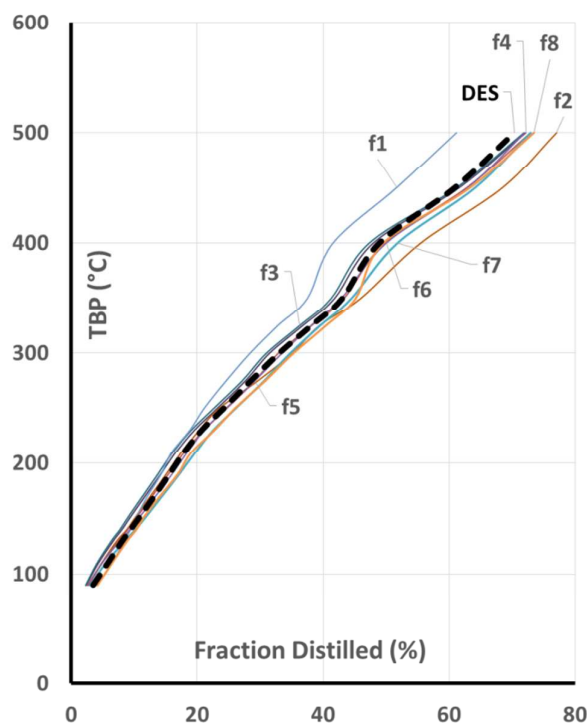


Figure S18. Best solution for CDU₁ at Example 5 using the sequential approach

Table S58. MCOBS schedule of the feedstocks for CDU₂ at the best solution to Example 5

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	7.02	9.58	11.25	14.58	20.42	22.92	26.25
end time (day)		7.02	9.58	11.25	14.58	20.42	22.92	26.25	28.75
added tank in	p ₁	tk ₁₆	tk ₁₅	tk ₁₉	tk ₁₇	tk ₁₈	tk ₂	tk ₂₁	tk ₂₃
	p ₂	tk ₂₉	-	tk ₂₈	tk ₃₀	tk ₂₅	tk ₁₃	tk ₂₄	tk ₂₇
tank sequence in	p ₁	tk ₁₆	tk ₁₅	tk ₁₉	tk ₁₇	tk ₁₈	tk ₂	tk ₂₁	tk ₂₃
	p ₂	tk ₂₉	tk ₂₉	tk ₂₈	tk ₃₀	tk ₂₅	tk ₁₃	tk ₂₄	tk ₂₇
emptied tank in	p ₁	tk ₁₆	tk ₁₅	tk ₁₉	tk ₁₇	tk ₁₈	tk ₂	tk ₂₁	tk ₂₃
	p ₂	-	tk ₂₉	tk ₂₈	tk ₃₀	tk ₂₅	tk ₁₃	tk ₂₄	tk ₂₇
crude oil in	p ₁	cr ₇	cr ₇	cr ₈	cr ₈	cr ₈	cr ₁	cr ₄	cr ₄
	p ₂	cr ₆	cr ₆	cr ₆	cr ₆	cr ₉	cr ₅	cr ₉	cr ₃
flow rate in	p ₁	296.6	244.1	250.0	250.0	142.9	333.3	250.0	333.3
(m ³ /h)	p ₂	203.4	255.9	250.0	250.0	357.1	166.7	250.0	166.7
batch size	p ₁	50,000	15,000	10,000	20,000	20,000	20,000	20,000	20,000
(m ³)	p ₂	34,279	15,721	10,000	20,000	50,000	10,000	20,000	10,000
sulfur (ppm)		1475	1575	1444	1444	637	1607	1693	2153

Table S59. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 5

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	6.46	5.46	3.92	3.92	2.79	2.52	2.57	3.00	2.35
90-110	3.37	2.85	2.26	2.26	1.96	1.99	2.44	2.62	1.83
110-130	2.64	2.18	1.04	1.04	1.73	2.46	2.74	2.93	2.50
130-140	1.16	0.96	1.03	1.03	1.22	1.56	1.37	1.55	1.01
140-150	0.81	0.68	1.95	1.95	1.67	1.20	1.36	1.47	1.36
150-170	2.39	2.02	2.81	2.81	2.94	2.52	2.53	2.70	2.72
170-190	2.00	1.74	2.04	2.04	2.42	2.51	2.58	2.75	2.53
190-210	1.94	1.73	2.07	2.07	2.64	2.36	2.74	2.68	3.19
210-230	2.30	2.06	2.33	2.33	2.63	2.61	2.83	3.13	3.13
230-250	3.35	2.98	3.47	3.47	3.84	3.24	3.57	3.79	4.06
250-275	3.94	3.62	3.00	3.00	3.92	5.68	4.08	4.40	4.93
275-300	4.47	4.19	3.99	3.99	5.01	5.20	4.17	3.65	4.98
300-325	5.01	4.78	4.36	4.36	4.45	4.31	4.77	5.29	5.15
325-350	4.69	4.65	4.13	4.13	3.96	5.87	4.81	5.23	5.22
350-400	5.20	4.97	4.32	4.32	4.78	8.67	6.43	6.90	4.76
400-450	10.45	10.31	10.12	10.12	10.42	13.34	10.14	12.29	15.75
450-500	8.86	9.35	9.14	9.14	9.13	8.84	8.95	9.48	9.87
>500	29.58	33.94	36.47	36.47	34.73	24.25	32.24	26.05	23.77

Table S60. TBP data of the feedstocks for CDU₂ at the best solution to Example 5

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	6.46	5.46	3.92	3.92	2.79	2.52	2.57	3.00	2.35
110	9.83	8.31	6.19	6.19	4.74	4.51	5.01	5.63	4.18
130	12.47	10.49	7.23	7.23	6.48	6.97	7.75	8.56	6.68
140	13.63	11.45	8.26	8.26	7.69	8.52	9.12	10.10	7.69
150	14.44	12.13	10.22	10.22	9.36	9.72	10.48	11.57	9.05
170	16.83	14.16	13.03	13.03	12.30	12.25	13.02	14.27	11.77
190	18.83	15.90	15.08	15.08	14.72	14.76	15.60	17.03	14.30
210	20.76	17.62	17.15	17.15	17.36	17.11	18.34	19.71	17.49
230	23.07	19.69	19.48	19.48	19.99	19.72	21.17	22.84	20.62
250	26.42	22.66	22.95	22.95	23.83	22.96	24.75	26.62	24.68
275	30.36	26.28	25.96	25.96	27.75	28.65	28.83	31.03	29.61
300	34.83	30.48	29.95	29.95	32.76	33.84	33.00	34.68	34.59
325	39.84	35.26	34.31	34.31	37.21	38.16	37.77	39.96	39.74
350	44.53	39.91	38.44	38.44	41.18	44.02	42.58	45.20	44.96
400	49.74	44.88	42.77	42.77	45.95	52.70	49.01	52.09	49.72
450	60.19	44.18	52.89	52.89	56.38	66.03	59.15	64.38	65.47
500	69.05	64.54	62.03	62.03	65.51	74.87	68.11	73.86	75.34

Example 5 - Sequential Approach
TBP curves of the feedstocks for CDU-2
15 charging tanks, 8 feedstocks

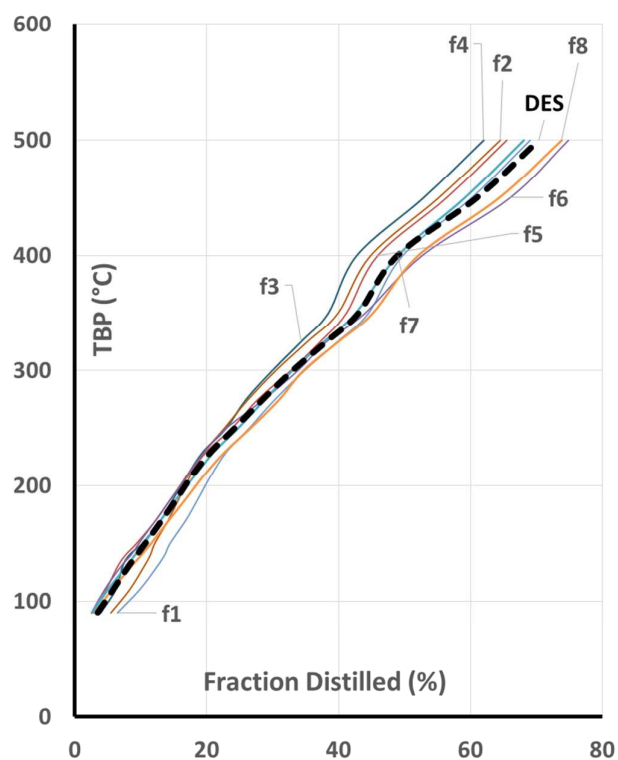


Figure S19. Best solution for CDU₂ at Example 5 using the sequential approach

II.5 Detailed results for Example 6 using the sequential approach

Table S61. MCOBS schedule for CDU₁ at the best solution to Example 6 using 9 time slots

		Best feedstock sequence for CDU ₁								
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉
start time (day)		0	6.67	10.00	13.16	15.00	18.33	20.00	21.92	26.67
end time (day)		6.67	10.00	13.16	15.00	18.33	20.00	21.92	26.67	30.00
added tank in	p ₁	tk ₁₆	tk ₁	tk ₃	tk ₁₀	tk ₁₇	tk ₁₉	tk ₂₀	tk ₂₁	tk ₂₃
	p ₂	tk ₁₄	tk ₁₂	tk ₈	-	tk ₃₀	tk ₂₈	tk ₂₅	-	tk ₂₆
tank sequence in	p ₁	tk ₁₆	tk ₁	tk ₃	tk ₁₀	tk ₁₇	tk ₁₉	tk ₂₀	tk ₂₁	tk ₂₃
	p ₂	tk ₁₄	tk ₁₂	tk ₈	tk ₈	tk ₃₀	tk ₂₈	tk ₂₅	tk ₂₅	tk ₂₆
emptied tank in	p ₁	tk ₁₆	tk ₁	tk ₃	tk ₁₀	tk ₁₇	tk ₁₉	tk ₂₀	tk ₂₁	tk ₂₃
	p ₂	tk ₁₄	tk ₁₂	-	tk ₈	tk ₃₀	tk ₂₈	-	tk ₂₅	tk ₂₆
crude oil in	p ₁	cr ₇	cr ₁	cr ₁	cr ₄	cr ₈	cr ₈	cr ₄	cr ₄	cr ₄
	p ₂	cr ₆	cr ₅	cr ₃	cr ₃	cr ₆	cr ₆	cr ₉	cr ₉	cr ₃
flow rate in	p ₁	312.5	250.0	395.0	227.0	250.0	250.0	216.9	175.6	250.0
(m ³ /h)	p ₂	187.5	250.0	105.0	273.0	250.0	250.0	283.1	324.4	250.0
batch size	p ₁	50,000	20,000	30,000	10,000	20,000	10,000	10,000	20,000	20,000
(m ³)	p ₂	30,000	20,000	7,978	12,022	20,000	10,000	13,052	36,948	20,000
sulfur (ppm)		1444	2195	506	1720	1444	1444	1541	1353	1814

Table S62. Microcut yields in the feedstock for CDU₁ at the best solution to Example 6

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)									Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
HK-90	6.76	2.61	2.03	2.33	3.92	3.92	2.37	2.13	2.47	3.56
90-110	3.53	2.20	1.30	1.89	2.26	2.26	2.26	2.04	2.04	2.36
110-130	2.78	2.43	2.19	2.33	1.04	1.04	2.59	2.40	2.46	2.29
130-140	1.22	1.58	1.39	1.35	1.03	1.03	1.31	1.23	1.39	1.30
140-150	0.85	1.22	1.03	1.18	1.95	1.95	1.29	1.19	1.24	1.25
150-170	2.50	2.50	2.43	2.46	2.81	2.81	2.46	2.37	2.51	2.53
170-190	2.07	2.54	2.33	2.47	2.04	2.04	2.50	2.40	2.53	2.39
190-210	2.00	2.43	2.11	2.39	2.07	2.07	2.69	2.62	2.45	2.28
210-230	2.37	2.74	2.36	2.91	2.33	2.33	2.75	2.64	2.96	2.72
230-250	3.47	3.22	3.27	3.61	3.47	3.47	3.51	3.43	3.65	3.39
250-275	4.04	6.15	4.74	4.51	3.00	3.00	4.06	4.04	4.48	4.26
275-300	4.55	5.46	4.57	3.84	3.99	3.99	4.28	4.41	3.80	4.30
300-325	5.08	4.30	4.52	5.26	4.36	4.36	4.70	4.61	5.27	4.78
325-350	4.70	6.53	4.54	5.01	4.13	4.13	4.71	4.58	5.05	4.84
350-400	5.27	9.58	6.36	6.14	4.32	4.32	6.21	5.94	6.30	5.88
400-450	10.50	13.01	14.62	13.79	10.12	10.12	10.17	10.20	13.46	11.76
450-500	8.71	8.54	10.15	10.56	9.14	9.14	9.11	9.30	10.33	9.39
>500	28.26	22.08	29.19	27.77	36.47	36.47	33.42	34.89	27.40	30.05

Table S63. TBP data of the feedstocks supplied to CDU₁ at the best solution to Example 6

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)									<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
90	6.76	2.61	2.03	2.33	3.92	3.92	2.37	2.13	2.47	3.56
110	10.29	4.81	3.34	4.21	6.19	6.19	4.63	4.17	4.52	5.92
130	13.07	7.24	5.54	6.55	7.23	7.23	7.23	6.57	6.98	8.21
140	14.29	8.82	6.92	7.89	8.26	8.26	8.54	7.80	8.37	9.51
150	15.14	10.04	7.96	9.07	10.22	10.22	9.82	9.00	9.61	10.76
170	17.64	12.55	10.39	11.53	13.03	13.03	12.28	11.37	12.12	13.29
190	19.71	15.09	12.72	14.01	15.08	15.08	14.79	13.77	14.66	15.68
210	21.71	17.52	14.83	16.40	17.15	17.15	17.48	16.39	17.11	17.96
230	24.09	20.27	17.19	19.31	19.48	19.48	20.22	19.04	20.07	20.68
250	27.56	23.49	20.46	22.93	22.95	22.95	23.73	22.47	23.72	24.07
275	31.59	29.64	25.20	27.43	25.96	25.96	27.80	26.51	28.21	28.33
300	36.15	35.11	29.78	31.27	29.95	29.95	32.08	30.92	32.01	32.63
325	41.23	39.41	34.30	36.54	34.31	34.31	36.77	35.53	37.28	37.41
350	45.93	45.94	38.84	41.55	38.44	38.44	41.48	40.10	42.33	42.25
400	51.20	55.52	45.20	47.69	42.77	42.77	47.69	46.04	48.64	48.13
450	61.70	68.53	59.82	61.48	52.89	52.89	57.86	62.25	62.10	59.89
500	70.41	77.07	69.98	72.04	62.03	62.03	66.97	65.55	72.43	69.28

Example 6 - Sequential approach
TBP curves of the feedstocks for CDU-1
16 charging tanks, 9 feedstocks

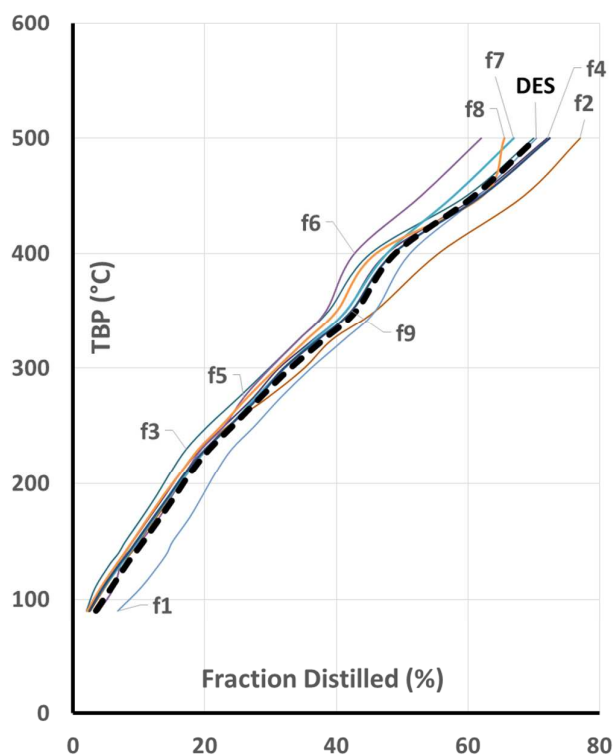


Figure 20. Best solution for CDU₁ at Example 6 using the sequential approach

Table S64. MCOBS schedule for CDU₂ at the solution to Example 6 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.54	7.08	11.94	15.42	19.58	21.67	24.17
end time (day)		3.54	7.08	11.94	15.42	19.58	21.67	24.17	27.08
added tank in	p ₁	tk ₅	tk ₁₅	tk ₆	tk ₁₈	tk ₉	tk ₄	tk ₂₂	tk ₁₁
	p ₂	tk ₇	-	tk ₂₉	-	tk ₂₄	tk ₁₃	tk ₂	tk ₂₇
tank sequence in	p ₁	tk ₅	tk ₁₅	tk ₆	tk ₁₈	tk ₉	tk ₄	tk ₂₂	tk ₁₁
	p ₂	tk ₇	tk ₇	tk ₂₉	tk ₂₉	tk ₂₄	tk ₁₃	tk ₂	tk ₂₇
emptied tank in	p ₁	tk ₅	tk ₁₅	tk ₆	tk ₁₈	tk ₉	tk ₄	tk ₂₂	tk ₁₁
	p ₂	-	tk ₇	-	tk ₂₉	tk ₂₄	tk ₁₃	tk ₂	tk ₂₇
crude oil in	p ₁	cr ₂	cr ₇	cr ₂	cr ₈	cr ₄	cr ₁	cr ₄	cr ₄
	p ₂	cr ₃	cr ₃	cr ₆	cr ₆	cr ₉	cr ₃	cr ₁	cr ₃
flow rate in	p ₁	235.7	176.2	257.3	239.7	300.0	300.0	166.7	357.1
(m ³ /h)	p ₂	264.3	323.8	242.7	260.3	200.0	200.0	333.3	142.9
batch size	p ₁	20,000	15,000	30,000	20,000	30,000	15,000	10,000	25,000
(m ³)	p ₂	22,434	27,566	28,290	21,710	20,000	10,000	20,000	10,000
sulfur (ppm)		1135	897	1771	1468	1921	1842	1231	2250

Table S65. Microcut yields in the feedstock for CDU₂ at the best solution to Example 6

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	3.96	4.22	4.20	3.80	2.87	2.56	2.91	3.15	3.56
90-110	2.21	2.10	2.44	2.19	2.71	2.07	2.31	2.79	2.36
110-130	2.35	2.24	1.98	1.00	2.97	2.45	2.96	3.06	2.29
130-140	1.40	1.28	1.01	0.99	1.47	1.57	1.63	1.59	1.30
140-150	1.03	0.83	0.84	1.88	1.47	1.21	1.41	1.53	1.25
150-170	2.66	2.60	1.94	2.71	2.64	2.52	2.73	2.76	2.53
170-190	2.79	2.27	2.24	1.98	2.71	2.52	2.70	2.82	2.39
190-210	2.15	2.11	1.69	2.02	2.82	2.39	2.51	2.75	2.28
210-230	3.55	2.73	2.92	2.27	2.96	2.66	2.71	3.17	2.72
230-250	3.29	3.79	2.32	3.38	3.67	3.23	3.54	3.83	3.39
250-275	4.80	4.89	3.54	2.97	4.12	5.87	4.57	4.38	4.26
275-300	4.47	4.70	3.84	3.95	4.01	5.30	4.22	3.61	4.30
300-325	5.14	5.46	4.40	4.34	4.88	4.31	4.67	5.29	4.78
325-350	4.71	4.64	4.70	4.14	4.97	6.13	4.89	5.28	4.84
350-400	4.42	5.09	4.10	4.31	6.76	9.04	7.26	7.07	5.88
400-450	14.01	14.89	10.15	10.10	10.10	13.21	12.64	11.95	11.76
450-500	10.24	10.79	9.40	9.25	8.72	8.72	8.88	9.24	9.39
>500	26.23	24.83	36.80	37.20	30.47	23.38	26.85	25.67	30.05

Table S66. TBP data of the feedstocks for CDU₂ at the best solution to Example 6

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	3.96	4.22	4.20	3.80	2.87	2.56	2.91	3.15	3.56
110	6.17	6.32	6.64	5.99	5.58	4.63	5.22	5.94	5.92
130	8.51	8.56	8.62	6.99	8.54	7.08	8.18	9.01	8.21
140	9.91	9.83	9.63	7.98	10.01	8.64	9.80	10.60	9.51
150	10.94	10.66	10.46	9.86	11.49	9.85	11.22	12.13	10.76
170	13.60	13.26	12.40	12.57	14.13	12.37	13.95	14.89	13.29
190	16.39	15.53	14.64	14.55	16.84	14.89	16.65	17.70	15.68
210	18.54	17.65	16.33	16.57	19.66	17.28	19.16	20.45	17.96
230	22.09	20.38	19.24	18.85	22.61	19.94	21.87	23.63	20.68
250	25.38	24.17	21.57	22.23	26.28	23.17	25.41	27.45	24.07
275	30.19	29.06	25.11	25.20	30.40	29.05	29.99	31.83	28.33
300	34.65	33.77	28.94	29.14	34.41	34.35	34.21	35.44	32.63
325	39.79	39.23	33.34	33.48	39.29	38.66	38.88	40.73	37.41
350	44.50	43.86	38.04	37.62	44.25	44.79	43.77	46.01	42.25
400	48.92	48.95	42.14	41.93	51.01	53.83	51.03	53.08	48.13
450	62.93	63.84	52.29	52.03	61.11	67.03	63.66	65.03	59.89
500	73.16	74.63	61.69	61.28	69.83	75.75	72.54	74.27	69.28

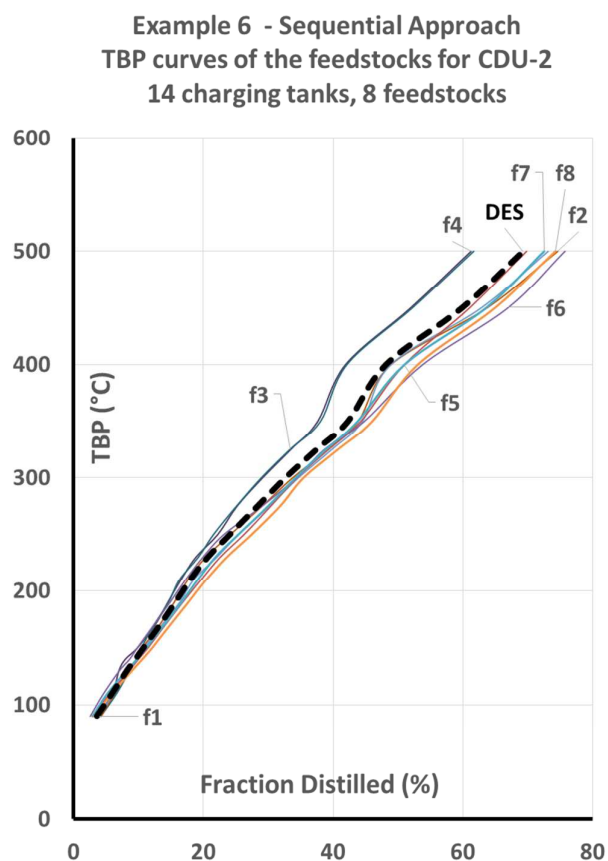


Figure S21. Best solution for CDU₂ at Example 6 using the sequential approach

II.6 Detailed results for Example 7 using the sequential approach

Table S67. Best MCOBS schedule for CDU₁ at the best solution to Example 7 using 8 time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	8.33	11.67	13.33	17.91	20.00	21.67	25.00
end time (day)		8.33	11.67	13.33	17.91	20.00	21.67	25.00	27.08
added tank in	p ₁	tk ₁₆	tk ₁₇	tk ₁₀	tk ₂₁	tk ₂₀	tk ₂₂	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₃₀	tk ₂₈	tk ₂₅	-	tk ₂₇	tk ₂₆	tk ₄
tank sequence in	p ₁	tk ₁₆	tk ₁₇	tk ₁₀	tk ₂₁	tk ₂₀	tk ₂₂	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₃₀	tk ₂₈	tk ₂₅	tk ₂₅	tk ₂₇	tk ₂₆	tk ₄
emptied tank in	p ₁	tk ₁₆	tk ₁₇	tk ₁₀	tk ₂₁	tk ₂₀	tk ₂₂	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₃₀	tk ₂₈	-	tk ₂₅	tk ₂₇	tk ₂₆	tk ₄
crude oil in	p ₁	cr ₇	cr ₈	cr ₄	cr ₄	cr ₄	cr ₄	cr ₄	cr ₅
	p ₂	cr ₃	cr ₆	cr ₆	cr ₉	cr ₉	cr ₃	cr ₃	cr ₁
flow rate in	p ₁	250.0	250.0	250.0	182.1	199.4	250.0	250.0	200.0
(m ³ /h)	p ₂	250.0	250.0	250.0	317.9	300.6	250.0	250.0	300.0
batch size	p ₁	50,000	20,000	10,000	20,000	10,000	10,000	20,000	10,000
(m ³)	p ₂	50,000	20,000	10,000	34,919	15,081	10,000	20,000	15,000
sulfur (ppm)		941	1444	2437	1383	1461	1814	1814	1842

Table S68. Microcut yields in the feedstock for CDU₁ at the best solution to Example 7

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	5.61	3.92	2.43	2.16	2.27	2.47	2.47	2.56	2.35
90-110	2.85	2.26	2.10	2.08	2.17	2.04	2.04	2.07	1.83
110-130	2.73	1.04	1.96	2.43	2.51	2.46	2.46	2.45	2.50
130-140	1.42	1.03	0.94	1.24	1.28	1.39	1.39	1.57	1.01
140-150	0.94	1.95	0.99	1.21	1.25	1.24	1.24	1.21	1.36
150-170	2.87	2.81	1.70	2.39	2.42	2.51	2.51	2.52	2.72
170-190	2.43	2.04	1.87	2.42	2.46	2.53	2.53	2.52	2.53
190-210	2.26	2.07	1.94	2.63	2.66	2.45	2.45	2.39	3.19
210-230	2.84	2.33	2.20	2.66	2.70	2.96	2.96	2.66	3.13
230-250	4.02	3.47	2.64	3.44	3.48	3.65	3.65	3.23	4.06
250-275	4.96	3.00	3.18	4.04	4.05	4.48	4.48	5.87	4.93
275-300	4.89	3.99	3.13	4.39	4.34	3.80	3.80	5.30	4.98
300-325	5.56	4.36	4.51	4.62	4.66	5.27	5.27	4.31	5.15
325-350	4.68	4.13	5.02	4.60	4.65	5.05	5.05	6.13	5.22
350-400	5.32	4.32	5.98	5.98	6.10	6.30	6.30	9.04	4.76
400-450	14.01	10.12	9.78	10.20	10.18	13.46	13.45	13.21	15.75
450-500	9.91	9.14	9.71	9.27	9.19	10.33	10.33	8.72	9.87
>500	22.06	36.47	38.79	34.66	34.04	27.40	27.40	23.38	23.77

Table S69. TBP data of the feedstocks for CDU₁ at the best solution to Example 7

TBP (°C)	Cumulative yield of the feedstock for CDU ₁ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	5.61	3.92	2.43	2.16	2.27	2.47	2.47	2.56	2.35
110	8.46	6.19	4.53	4.24	4.44	4.52	4.52	4.63	4.18
130	11.20	7.23	6.49	6.67	6.95	6.98	6.98	7.08	6.68
140	12.62	8.26	7.44	7.92	8.22	8.37	8.37	8.64	7.69
150	13.56	10.22	8.43	9.12	9.47	9.61	9.61	9.85	9.05
170	16.44	13.03	10.14	11.51	11.90	12.12	12.12	12.37	11.77
190	18.87	15.08	12.01	13.93	14.36	14.66	14.66	14.89	14.30
210	21.13	17.15	13.96	16.56	17.02	17.11	17.11	17.28	17.49
230	23.97	19.48	16.16	19.22	19.72	20.07	20.07	19.94	20.62
250	28.00	22.95	18.81	22.67	23.20	23.72	23.72	23.17	24.68
275	32.96	25.96	21.99	26.71	27.25	28.21	28.21	29.05	29.61
300	37.85	29.95	25.12	31.10	31.59	32.01	32.01	34.35	34.59
325	43.41	34.31	29.63	35.72	36.24	37.28	37.28	38.66	39.74
350	48.10	38.44	34.66	40.32	40.90	42.33	42.33	44.79	44.96
400	53.42	42.77	40.64	46.30	46.99	48.64	48.64	53.83	49.72
450	67.43	52.89	50.42	56.50	57.17	62.10	62.10	67.03	65.47
500	77.34	62.03	60.13	65.77	66.37	72.43	72.43	75.75	75.34

Example 7 - Sequential Approach
TBP curves of the feedstocks for CDU-1
15 charging tanks, 8 feedstocks

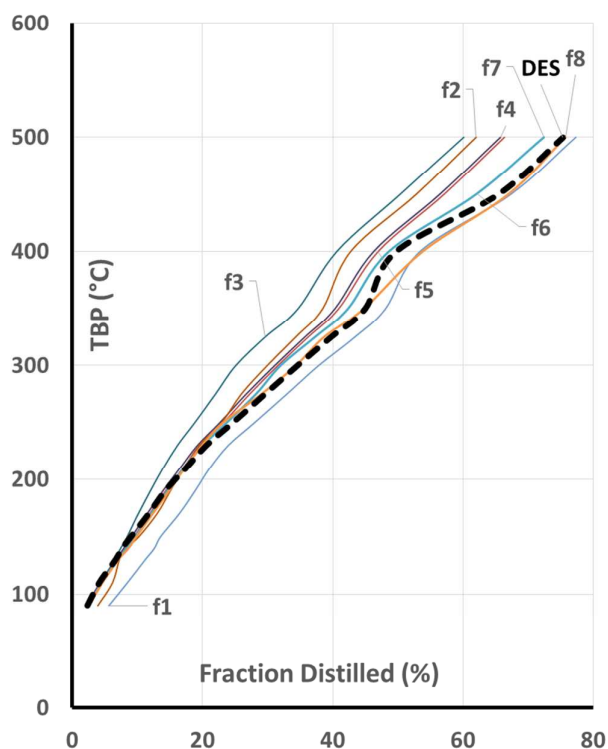


Figure S22. TBP curves of the feedstocks for CDU₁ at the best solution for Example 7

Table S70. Best MCOBS schedule for CDU₂ at the best solution to Example 7 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	2.92	6.25	9.58	13.89	17.92	22.92	26.25
end time (day)		2.92	6.25	9.58	13.89	17.92	22.92	26.25	30.00
added tank in	p ₁	tk ₁₅	tk ₁₉	tk ₁₂	tk ₉	tk ₁₈	tk ₆	tk ₅	tk ₁₁
	p ₂	tk ₈	tk ₃	tk ₁	tk ₂₉	-	tk ₁₄	tk ₂₄	tk ₂
tank sequence in	p ₁	tk ₁₅	tk ₁₉	tk ₁₂	tk ₉	tk ₁₈	tk ₆	tk ₅	tk ₁₁
	p ₂	tk ₈	tk ₃	tk ₁	tk ₂₉	tk ₂₉	tk ₁₄	tk ₂₄	tk ₂
emptied tank in	p ₁	tk ₁₅	tk ₁₉	tk ₁₂	tk ₉	tk ₁₈	tk ₆	tk ₅	tk ₁₁
	p ₂	tk ₈	tk ₃	tk ₁	-	tk ₂₉	tk ₁₄	tk ₂₄	tk ₂
crude oil in	p ₁	cr ₇	cr ₈	cr ₅	cr ₄	cr ₈	cr ₂	cr ₂	cr ₄
	p ₂	cr ₃	cr ₁	cr ₁	cr ₆	cr ₆	cr ₆	cr ₉	cr ₁
flow rate in	p ₁	214.3	125.0	250.0	290.0	207.1	250.0	250.0	277.8
(m ³ /h)	p ₂	285.7	375.0	2500	210.0	292.9	250.0	250.0	222.2
batch size	p ₁	15,000	10,000	20,000	30,000	20,000	30,000	20,000	25,000
(m ³)	p ₂	20,000	30,000	20,000	21,717	28,283	30,000	20,000	20,000
sulfur (ppm)		920	535	2195	2500	1546	1779	1035	1765

Table S71. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 7

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.94	3.52	2.61	2.69	3.39	4.10	4.24	3.30	3.50
90-110	2.49	2.20	2.20	2.37	1.95	2.38	2.72	2.80	2.35
110-130	2.49	2.38	2.43	2.27	0.87	1.92	2.70	3.26	2.30
130-140	1.35	1.64	1.58	1.09	0.86	0.98	1.41	1.70	1.30
140-150	0.89	1.83	1.22	1.14	1.63	0.81	1.18	1.58	1.28
150-170	2.74	3.24	2.50	1.92	2.39	1.89	2.72	2.85	2.50
170-190	2.35	2.72	2.54	2.09	1.79	2.19	2.90	2.86	2.40
190-210	2.19	2.50	2.43	2.14	1.85	1.66	2.46	2.72	2.30
210-230	2.79	2.68	2.74	2.41	2.09	2.86	3.48	2.96	2.80
230-250	3.91	3.89	3.22	2.87	3.09	2.29	3.22	3.71	3.50
250-275	4.93	4.53	6.15	3.35	2.85	3.50	4.40	4.46	4.30
275-300	4.80	4.76	5.46	3.16	3.80	3.81	4.85	3.93	4.50
300-325	5.51	4.51	4.30	4.64	4.25	4.38	4.63	4.88	5.10
325-350	4.66	4.35	6.53	5.11	4.19	4.69	4.47	5.12	4.90
350-400	5.21	6.33	9.58	6.32	4.25	4.09	4.54	7.53	5.90
400-450	14.44	13.14	13.01	9.80	10.04	10.14	10.5	11.73	12.00
450-500	10.33	8.73	8.54	9.40	9.57	9.46	8.70	8.51	9.40
>500	23.40	26.12	22.08	36.32	39.51	37.30	30.75	25.68	29.67

Table S72. TBP curves of the feedstocks for CDU₂ at the best solution to Example 7

TBP (°C)	Cumulative yield of the feedstock for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.94	3.52	2.61	2.69	3.39	4.10	4.24	3.30	3.50
110	7.43	5.72	4.81	5.06	5.34	6.48	6.96	6.09	5.85
130	9.92	8.10	7.24	7.33	6.21	8.41	9.66	9.35	8.15
140	11.27	9.74	8.82	8.42	7.07	9.39	11.07	11.05	9.45
150	12.16	11.57	10.04	9.56	8.70	10.20	12.25	12.64	10.73
170	14.90	14.82	12.55	11.49	11.09	12.09	14.97	15.49	13.23
190	17.25	17.54	15.09	13.58	12.88	14.28	17.87	18.35	15.63
210	19.44	20.04	17.52	15.71	14.73	15.95	20.33	21.07	17.93
230	22.23	22.72	20.27	18.12	16.82	18.81	23.82	24.04	20.73
250	26.15	26.61	23.49	20.99	19.91	21.10	27.04	27.75	24.23
275	31.07	31.14	29.64	24.34	22.76	24.60	31.44	32.21	28.53
300	35.88	35.90	35.11	27.50	26.57	28.41	36.29	36.14	33.03
325	41.39	40.41	39.41	32.15	30.82	32.79	40.93	41.03	38.13
350	46.05	44.76	45.94	37.26	35.01	37.48	45.40	46.15	43.03
400	51.26	51.09	55.52	43.58	39.25	41.57	49.94	53.68	48.93
450	65.69	64.24	68.53	53.38	49.29	51.71	60.44	65.42	60.93
500	76.03	72.97	77.07	62.79	58.87	61.17	69.14	73.93	70.33

Example 7 - Sequential Approach
TBP curves of the feedstocks for CDU-2
15 charging tanks, 8 feedstocks

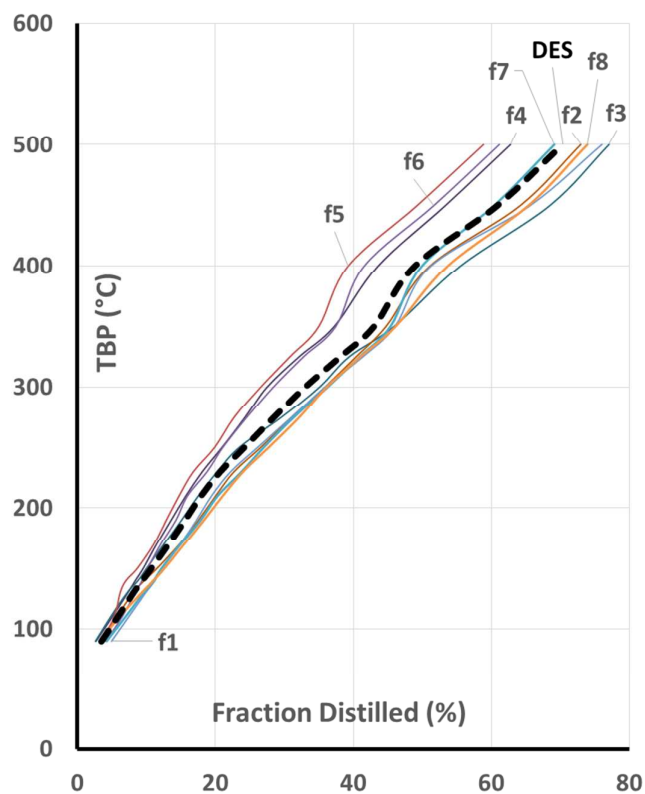


Figure S23. TBP curves of the feedstocks for CDU₂ at the best solution for Example 7

II.7 Detailed results for Example 8 using the sequential approach

Table S73. MCOBS schedule for CDU₁ at the best solution to Example 8 using 8 time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	5.00	9.76	12.50	14.58	16.25	19.58	22.08
end time (day)		5.00	9.76	12.50	14.58	16.25	19.58	22.08	25.42
added tank in	p ₁	tk ₆	tk ₄₀	tk ₃₆	tk ₁₃	tk ₁₀	tk ₁₈	tk ₄₁	tk ₂₁
	p ₂	tk ₁₄	tk ₇	-	tk ₄	tk ₄₃	tk ₃₀	tk ₃₂	tk ₂
tank sequence in	p ₁	tk ₆	tk ₄₀	tk ₃₆	tk ₁₃	tk ₁₀	tk ₁₈	tk ₄₁	tk ₂₁
	p ₂	tk ₁₄	tk ₇	tk ₇	tk ₄	tk ₄₃	tk ₃₀	tk ₃₂	tk ₂
emptied tank in	p ₁	tk ₆	tk ₄₀	tk ₃₆	tk ₁₃	tk ₁₀	tk ₁₈	tk ₄₁	tk ₂₁
	p ₂	tk ₁₄	-	tk ₇	tk ₄	tk ₄₃	tk ₃₀	tk ₃₂	tk ₂
crude oil in	p ₁	cr ₂	cr ₇	cr ₄	cr ₅	cr ₄	cr ₈	cr ₈	cr ₄
	p ₂	cr ₆	cr ₃	cr ₃	cr ₁	cr ₉	cr ₆	cr ₁	cr ₁
flow rate in	p ₁	250.0	175.2	303.9	200.0	250.0	250.0	166.7	250.0
(m ³ /h)	p ₂	250.0	324.8	196.1	300.0	250.0	250.0	333.3	250.0
batch size	p ₁	30,000	20,000	20,000	10,000	10,000	20,000	10,000	20,000
(m ³)	p ₂	30,000	37,095	12,905	15,000	10,000	20,000	20,000	20,000
sulfur (ppm)		1779	897	2033	1842	1693	1444	569	1632

Table S74. Microcut yields in the feedstocks for CDU₁ at the best solution to Example 8

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.10	4.20	2.82	2.56	2.57	3.29	3.91	3.20	3.63
90-110	2.38	2.09	2.42	2.07	2.44	2.26	2.41	2.67	2.35
110-130	1.92	2.23	2.76	2.45	2.74	1.04	2.35	3.18	2.25
130-140	0.98	1.27	1.49	1.57	1.37	1.03	1.68	1.68	1.30
140-150	0.81	0.83	1.39	1.21	1.36	1.95	2.05	1.54	1.26
150-170	1.89	2.60	2.64	2.52	2.53	2.81	3.47	2.82	2.56
170-190	2.19	2.26	2.68	2.52	2.58	2.04	2.81	2.82	2.40
190-210	1.66	2.11	2.60	2.39	2.74	2.07	2.60	2.67	2.26
210-230	2.86	2.73	3.07	2.66	2.83	2.33	2.80	2.90	2.76
230-250	2.29	3.79	3.74	3.23	3.57	3.47	4.09	3.67	3.40
250-275	3.50	4.89	4.43	5.87	4.08	3.00	4.46	4.49	4.28
275-300	3.81	4.70	3.70	5.30	4.17	3.99	4.80	4.00	4.33
300-325	4.38	5.46	5.28	4.31	4.77	4.36	4.57	4.83	4.79
325-350	4.69	4.64	5.17	6.13	4.81	4.13	4.29	5.06	4.81
350-400	4.09	5.08	6.69	9.04	6.43	4.32	6.16	7.46	4.74
400-450	10.14	14.90	12.70	13.21	10.14	10.12	12.86	11.96	11.92
450-500	9.46	10.80	9.78	8.72	8.95	9.14	8.50	8.60	9.43
>500	37.30	24.87	26.53	23.38	32.24	36.47	25.30	25.97	29.80

Table S75. TBP data of the feedstocks for CDU₁ at the best solution to Example 8

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.10	4.20	2.82	2.56	2.57	3.29	3.91	3.20	3.63
110	6.48	6.29	5.24	4.63	5.01	6.19	6.32	5.87	5.98
130	8.41	8.42	8.00	7.08	7.75	7.23	8.67	9.06	8.23
140	9.39	9.79	9.49	8.64	9.12	8.26	10.35	10.74	9.53
150	10.20	10.62	10.88	9.85	10.48	10.22	12.41	12.28	10.79
170	12.09	13.22	13.51	12.37	13.02	13.03	15.88	15.10	13.35
190	14.28	15.48	16.19	14.89	15.60	15.08	18.69	17.92	15.75
210	15.95	17.60	18.79	17.28	18.34	17.15	21.29	20.59	18.01
230	18.81	20.33	21.86	19.94	21.17	19.48	24.09	23.49	20.77
250	21.10	24.12	25.60	23.17	24.75	22.95	28.18	27.16	24.17
275	24.60	29.01	30.03	29.05	28.83	25.96	32.63	31.65	28.45
300	28.41	33.71	33.73	34.35	33.00	29.95	37.43	35.66	32.78
325	32.79	39.17	39.02	38.66	37.77	34.31	42.00	40.49	37.57
350	37.48	43.80	44.19	44.79	42.58	38.44	46.29	45.55	42.38
400	41.57	48.89	50.87	53.83	49.01	42.77	52.45	53.02	47.12
450	51.71	63.79	63.58	67.03	59.15	52.89	65.31	64.98	59.04
500	61.17	74.59	73.36	75.75	68.11	62.03	73.81	73.58	68.47

Example 8 - Sequential Approach
TBP curves of the feedstocks for CDU-1
15 charging tanks, 8 feedstocks

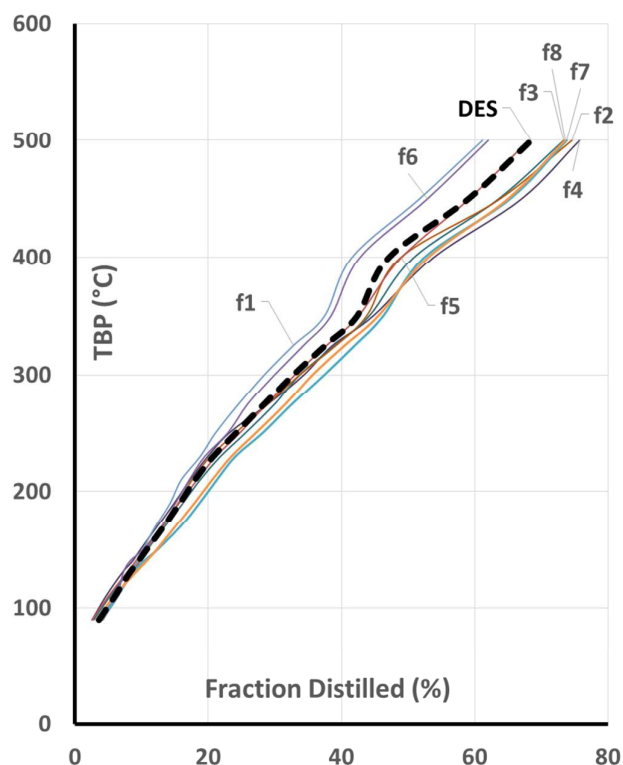


Figure S24. Best solution for CDU₁ at Example 8 using the sequential approach

Table S76. MCOBS schedule for CDU₂ at the best solution to Example 8 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.33	7.50	9.58	14.26	17.92	20.42	23.75
end time (day)		3.33	7.50	9.58	14.26	17.92	20.42	23.75	27.08
added tank in	p ₁	tk ₁	tk ₉	tk ₁₅	tk ₃₃	tk ₁₇	tk ₂₂	tk ₁₉	tk ₅
	p ₂	tk ₁₂	tk ₈	tk ₂₈	tk ₂₉	-	tk ₂₄	tk ₃	tk ₄₅
tank sequence in	p ₁	tk ₁	tk ₉	tk ₁₅	tk ₃₃	tk ₁₇	tk ₂₂	tk ₁₉	tk ₅
	p ₂	tk ₁₂	tk ₈	tk ₂₈	tk ₂₉	tk ₂₉	tk ₂₄	tk ₃	tk ₄₅
emptied tank in	p ₁	tk ₁	tk ₉	tk ₁₅	tk ₃₃	tk ₁₇	tk ₂₂	tk ₁₉	tk ₅
	p ₂	tk ₁₂	tk ₈	tk ₂₈	-	tk ₂₉	tk ₂₄	tk ₃	tk ₄₅
crude oil in	p ₁	cr ₁	cr ₄	cr ₇	cr ₂	cr ₈	cr ₄	cr ₈	cr ₂
	p ₂	cr ₅	cr ₃	cr ₆	cr ₆	cr ₆	cr ₉	cr ₁	cr ₃
flow rate in	p ₁	250.0	300.0	300.0	267.0	228.2	166.7	125.0	250.0
(m ³ /h)	p ₂	250.0	200.0	200.0	233.0	271.8	333.3	375.0	250.0
batch size	p ₁	20,000	30,000	15,000	30,000	20,000	10,000	10,000	20,000
(m ³)	p ₂	20,000	20,000	10,000	26,178	23,822	20,000	30,000	20,000
sulfur (ppm)		2195	2017	1468	1761	1496	1312	535	1156

Table S77. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 8

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	2.61	2.79	6.52	4.32	3.65	2.07	3.52	4.14	3.63
90-110	2.20	2.39	3.41	2.52	2.10	1.99	2.20	2.32	2.35
110-130	2.43	2.74	2.67	2.05	0.96	2.36	2.38	2.42	2.25
130-140	1.58	1.48	1.17	1.04	0.94	1.21	1.64	1.42	1.30
140-150	1.22	1.38	0.82	0.87	1.79	1.17	1.83	1.06	1.26
150-170	2.50	2.63	2.41	2.00	2.60	2.35	3.24	2.70	2.56
170-190	2.54	2.67	2.01	2.30	1.91	2.38	2.72	2.85	2.40
190-210	2.43	2.59	1.95	1.73	1.96	2.61	2.50	2.17	2.26
210-230	2.74	3.06	2.32	2.99	2.21	2.62	2.68	3.61	2.76
230-250	3.22	3.73	3.38	2.36	3.27	3.41	3.89	3.29	3.40
250-275	6.15	4.44	3.96	3.59	2.93	4.03	4.53	4.80	4.28
275-300	5.46	3.71	4.49	3.87	3.90	4.44	4.76	4.48	4.33
300-325	4.30	5.28	5.02	4.43	4.31	4.59	4.51	5.13	4.79
325-350	6.53	5.16	4.69	4.71	4.16	4.55	4.35	4.72	4.81
350-400	9.58	6.66	5.22	4.10	4.29	5.88	6.33	4.41	4.74
400-450	13.01	12.76	10.46	10.17	10.08	10.21	13.14	13.82	11.92
450-500	8.54	9.82	8.82	9.31	9.36	9.35	8.73	10.07	9.43
>500	22.08	26.59	29.30	36.15	38.02	35.21	26.12	25.91	29.80

Table S78. TBP data of the feedstocks for CDU₂ at the best solution to Example 8

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	2.61	2.79	6.52	4.32	3.65	2.07	3.52	4.14	3.63
110	4.81	5.18	9.93	6.84	5.75	4.07	5.72	6.47	5.98
130	7.24	7.93	12.60	8.89	6.72	6.43	8.10	8.89	8.23
140	8.82	9.41	13.77	9.94	7.66	7.64	9.74	10.32	9.53
150	10.04	10.79	14.59	10.80	9.45	8.82	11.57	11.38	10.79
170	12.55	13.41	17.00	12.80	12.05	11.17	14.82	14.08	13.35
190	15.09	16.08	19.02	15.10	13.96	13.55	17.54	16.93	15.75
210	17.52	18.67	20.97	16.83	15.92	16.16	20.04	19.10	18.01
230	20.27	21.73	23.28	19.82	18.13	18.78	22.72	22.72	20.77
250	23.49	25.46	26.66	22.18	21.41	22.19	26.61	26.01	24.17
275	29.64	29.90	30.62	25.78	24.33	26.23	31.14	30.82	28.45
300	35.11	33.61	35.11	29.65	28.23	30.67	35.90	35.30	32.78
325	39.41	38.89	40.14	34.07	32.54	35.26	40.41	40.43	37.57
350	45.94	44.05	44.83	38.78	36.70	39.81	44.76	45.15	42.38
400	55.52	50.71	50.05	42.88	40.98	45.69	51.09	49.57	47.12
450	68.53	63.47	60.51	53.06	51.06	55.90	62.24	63.39	59.04
500	77.07	73.29	69.34	62.37	60.42	65.24	72.97	73.47	68.47

Example 8 - Sequential Approach
TBP curves of the feedstocks for CDU-2
15 charging tanks, 8 feedstocks

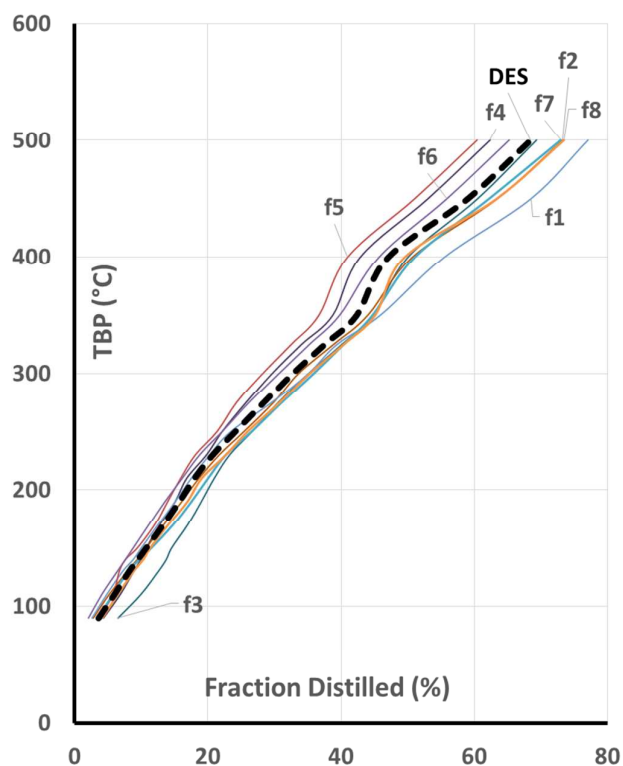


Figure S25. Best solution for CDU₂ at Example 8 using the sequential approach

Table S79. MCOBS schedule for CDU₃ at the best solution to Example 8 using 8 time slots

		Best feedstock sequence for CDU ₃							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.25	10.00	11.67	13.33	17.08	20.42	22.92
end time (day)		3.25	10.00	11.67	13.33	17.08	20.42	22.92	26.25
added tank in	p ₁	tk ₁₆	-	tk ₃₁	tk ₂₀	tk ₁₁	tk ₂₃	tk ₃₄	tk ₄₂
	p ₂	tk ₃₉	tk ₂₅	tk ₃₇	tk ₂₇	tk ₃₅	tk ₄₄	tk ₂₆	tk ₃₈
tank sequence in	p ₁	tk ₁₆	tk ₁₆	tk ₃₁	tk ₂₀	tk ₁₁	tk ₂₃	tk ₃₄	tk ₄₂
	p ₂	tk ₃₉	tk ₂₅	tk ₃₇	tk ₂₇	tk ₃₅	tk ₄₄	tk ₂₆	tk ₃₈
emptied tank in	p ₁	-	tk ₁₆	tk ₃₁	tk ₂₀	tk ₁₁	tk ₂₃	tk ₃₄	tk ₄₂
	p ₂	tk ₃₉	tk ₂₅	tk ₃₇	tk ₂₇	tk ₃₅	tk ₄₄	tk ₂₆	tk ₃₈
crude oil in	p ₁	cr ₇	cr ₇	cr ₁	cr ₄	cr ₄	cr ₄	cr ₂	cr ₈
	p ₂	cr ₆	cr ₉	cr ₅	cr ₃	cr ₃	cr ₃	cr ₃	cr ₆
flow rate in	p ₁	243.8	191.2	250.0	250.0	277.8	250.0	166.7	250.0
(m ³ /h)	p ₂	256.2	308.8	250.0	250.0	222.2	250.0	333.3	250.0
batch size	p ₁	19,036	30,964	10,000	10,000	25,000	20,000	10,000	20,000
(m ³)	p ₂	20,000	50,000	10,000	10,000	20,000	20,000	20,000	20,000
sulfur (ppm)		1575	757	2195	1814	1927	1814	1035	1444

Table S80. Microcut yields in the feedstocks for CDU₃ at the best solution to Example 8

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₃ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	5.45	4.62	2.61	2.47	2.65	2.47	3.06	3.92	3.63
90-110	2.85	2.74	2.20	2.04	2.24	2.04	1.65	2.26	2.35
110-130	2.18	2.68	2.43	2.46	2.62	2.46	1.97	1.04	2.25
130-140	0.96	1.29	1.58	1.39	1.44	1.39	1.26	1.03	1.30
140-150	0.68	1.00	1.22	1.24	1.32	1.24	0.89	1.95	1.26
150-170	2.02	2.68	2.50	2.51	2.58	2.51	2.45	2.81	2.56
170-190	1.74	2.36	2.54	2.53	2.61	2.53	2.53	2.04	2.40
190-210	1.72	2.50	2.43	2.45	2.53	2.45	2.04	2.07	2.26
210-230	2.06	2.59	2.74	2.96	3.02	2.96	3.23	2.33	2.76
230-250	2.98	3.75	3.22	3.65	3.70	3.65	3.28	3.47	3.40
250-275	3.62	4.41	6.15	4.48	4.46	4.48	4.78	3.00	4.28
275-300	4.19	5.20	5.46	3.80	3.75	3.80	4.40	3.99	4.33
300-325	4.78	4.86	4.30	5.27	5.28	5.27	5.16	4.36	4.79
325-350	4.65	4.34	6.53	5.05	5.11	5.05	4.65	4.13	4.81
350-400	4.97	5.29	9.58	6.30	6.50	6.30	4.45	4.32	4.74
400-450	10.31	10.61	13.01	13.46	13.07	13.46	14.88	10.12	11.92
450-500	9.35	8.91	8.54	10.33	10.05	10.33	11.01	9.14	9.43
>500	33.96	30.25	22.08	27.40	26.95	27.40	27.75	36.47	29.80

Table S81. TBP data of the feedstocks for CDU₃ at the best solution to Example 8

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₃ (%)								$cydref_{mc}$
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	2.61	2.79	6.52	4.32	3.65	2.07	3.52	4.14	3.63
110	4.81	5.18	9.93	6.84	5.75	4.07	5.72	6.47	5.98
130	7.24	7.93	12.60	8.89	6.72	6.43	8.10	8.89	8.23
140	8.82	9.41	13.77	9.94	7.66	7.64	9.74	10.32	9.53
150	10.04	10.79	14.59	10.80	9.45	8.82	11.57	11.38	10.79
170	12.55	13.41	17.00	12.80	12.05	11.17	14.82	14.08	13.35
190	15.09	16.08	19.02	15.10	13.96	13.55	17.54	16.93	15.75
210	17.52	18.67	20.97	16.83	15.92	16.16	20.04	19.10	18.01
230	20.27	21.73	23.28	19.82	18.13	18.78	22.72	22.72	20.77
250	23.49	25.46	26.66	22.18	21.41	22.19	26.61	26.01	24.17
275	29.64	29.90	30.62	25.78	24.33	26.23	31.14	30.82	28.45
300	35.11	33.61	35.11	29.65	28.23	30.67	35.90	35.30	32.78
325	39.41	38.89	40.14	34.07	32.54	35.26	40.41	40.43	37.57
350	45.94	44.05	44.83	38.78	36.70	39.81	44.76	45.15	42.38
400	55.52	50.71	50.05	42.88	40.98	45.69	51.09	49.57	47.12
450	68.53	63.47	60.51	53.06	51.06	55.90	62.24	63.39	59.04
500	77.07	73.29	69.34	62.37	60.42	65.24	72.97	73.47	68.47

Example 8 - Sequential Approach
TBP curves of the feedstocks for CDU-3
15 charging tanks, 8 feedstocks

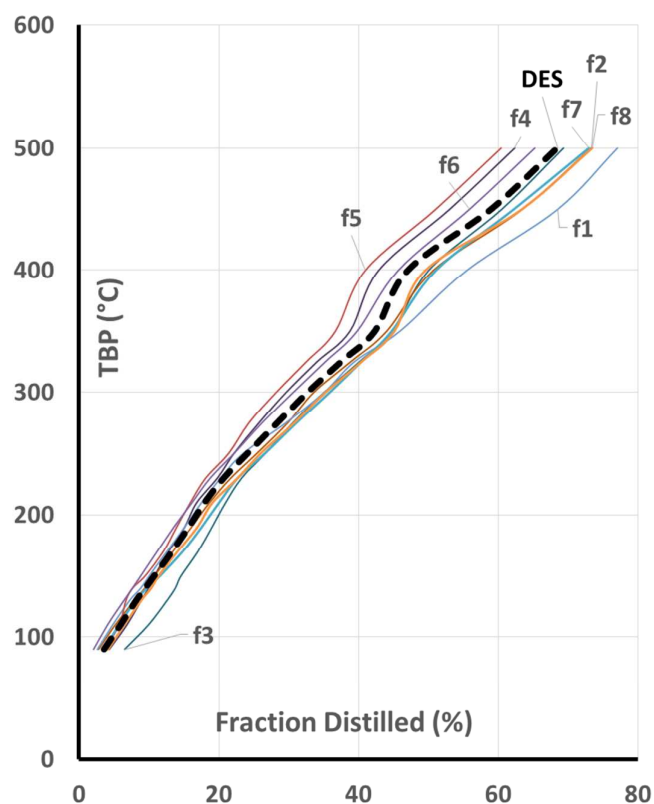


Figure S26. Best solution for CDU₃ at Example 8 using the sequential approach

II.8 Detailed results for Example 9 using the sequential approach

Table S82. MCOBS schedule for CDU₁ at the best solution to Example 9 using 8 time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	6.67	9.58	12.08	16.25	17.67	19.58	22.92
end time (day)		6.67	9.58	12.08	16.25	17.67	19.58	22.92	27.08
added tank in	p ₁	tk ₁₆	tk ₁₅	tk ₄₂	tk ₉	tk ₂₂	tk ₃₄	tk ₅	tk ₃₃
	p ₂	tk ₁₄	tk ₂₆	tk ₂₈	tk ₈	tk ₄₄	-	tk ₄₅	tk ₃₉
tank sequence in	p ₁	tk ₁₆	tk ₁₅	tk ₄₂	tk ₉	tk ₂₂	tk ₃₄	tk ₅	tk ₃₃
	p ₂	tk ₁₄	tk ₂₆	tk ₂₈	tk ₈	tk ₄₄	tk ₄₄	tk ₄₅	tk ₃₉
emptied tank in	p ₁	tk ₁₆	tk ₁₅	tk ₄₂	tk ₉	tk ₂₂	tk ₃₄	tk ₅	tk ₃₃
	p ₂	tk ₁₄	tk ₂₆	tk ₂₈	tk ₈	-	tk ₄₄	tk ₄₅	tk ₃₉
crude oil in	p ₁	cr ₇	cr ₇	cr ₈	cr ₄	cr ₄	cr ₂	cr ₂	cr ₂
	p ₂	cr ₆	cr ₃	cr ₆	cr ₃	cr ₃	cr ₃	cr ₃	cr ₆
flow rate in	p ₁	312.5	214.3	333.3	300.0	293.1	218.0	250.0	300.0
(m ³ /h)	p ₂	187.5	285.7	166.7	200.0	206.9	282.0	250.0	200.0
batch size	p ₁	50,000	15,000	20,000	30,000	10,000	10,000	20,000	30,000
(m ³)	p ₂	30,000	20,000	10,000	20,000	7,059	12,941	20,000	20,000
sulfur (ppm)		1444	920	1245	2017	1989	1110	1156	1727

Table S83. Microcut yields in the feedstocks for CDU₁ at the best solution to Example 9

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	6.76	4.94	4.97	2.79	2.75	3.73	4.14	4.76	2.35
90-110	3.53	2.49	2.88	2.39	2.34	2.07	2.32	2.78	1.83
110-130	2.78	2.49	1.38	2.74	2.70	2.25	2.42	2.30	2.50
130-140	1.22	1.35	1.36	1.48	1.47	1.36	1.42	1.17	1.01
140-150	0.85	0.89	2.58	1.38	1.36	1.00	1.06	0.96	1.36
150-170	2.50	2.74	3.64	2.63	2.61	2.60	2.70	2.20	2.72
170-190	2.07	2.35	2.54	2.67	2.65	2.73	2.85	2.52	2.53
190-210	2.00	2.19	2.52	2.59	2.57	2.12	2.17	1.85	3.19
210-230	2.37	2.79	2.79	3.06	3.05	3.47	3.61	3.24	3.13
230-250	3.47	3.91	4.22	3.73	3.72	3.29	3.29	2.50	4.06
250-275	4.04	4.93	3.30	4.44	4.44	4.79	4.80	3.78	4.93
275-300	4.55	4.80	4.35	3.71	3.72	4.45	4.48	3.99	4.98
300-325	5.08	5.51	4.58	5.28	5.28	5.15	5.13	4.51	5.15
325-350	4.70	4.66	4.02	5.16	5.15	4.69	4.72	4.74	5.22
350-400	5.27	5.21	4.47	6.66	6.61	4.43	4.41	4.13	4.76
400-450	10.50	14.44	10.28	12.76	12.85	14.23	13.82	10.24	15.75
450-500	8.71	10.33	8.31	9.82	9.89	10.43	10.07	9.02	9.87
>500	28.26	23.40	30.55	26.59	26.70	26.62	25.91	33.92	23.77

Table S84. TBP data of the feedstocks for CDU₁ at the best solution to Example 9

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	6.76	4.94	4.97	2.79	2.75	3.73	4.14	4.76	2.35
110	10.29	7.43	7.84	5.18	5.09	5.79	6.47	7.54	4.18
130	13.07	9.92	9.22	7.93	7.80	8.04	8.89	9.84	6.68
140	14.29	11.27	10.58	9.41	9.27	9.40	10.32	11.01	7.69
150	15.14	12.16	13.17	10.79	10.62	10.40	11.38	11.97	9.05
170	17.64	14.90	16.81	13.41	13.24	13.00	14.08	14.17	11.77
190	19.71	17.25	19.35	16.08	15.88	15.73	16.93	16.69	14.30
210	21.71	19.44	21.87	18.67	18.46	17.85	19.10	18.54	17.49
230	24.09	22.23	24.66	21.73	21.50	21.32	22.72	21.78	20.62
250	27.56	26.15	28.87	25.46	25.22	24.61	26.01	24.28	24.68
275	31.59	31.07	32.17	29.90	29.67	29.40	30.82	28.06	29.61
300	36.15	35.88	36.52	33.61	33.39	33.85	35.30	32.05	34.59
325	41.23	41.39	41.11	38.89	38.67	39.00	40.43	36.56	39.74
350	45.93	46.05	45.13	44.05	43.81	43.69	45.15	41.30	44.96
400	51.20	51.26	49.60	50.71	50.43	48.12	49.57	45.43	49.72
450	61.70	65.69	59.88	63.47	63.28	62.35	63.39	55.57	65.47
500	70.41	76.03	68.19	73.29	73.17	72.79	73.47	64.69	75.34

Example 9 - Sequential Approach
TBP curves of the feedstocks for CDU-1
15 charging tanks, 8 feedstocks

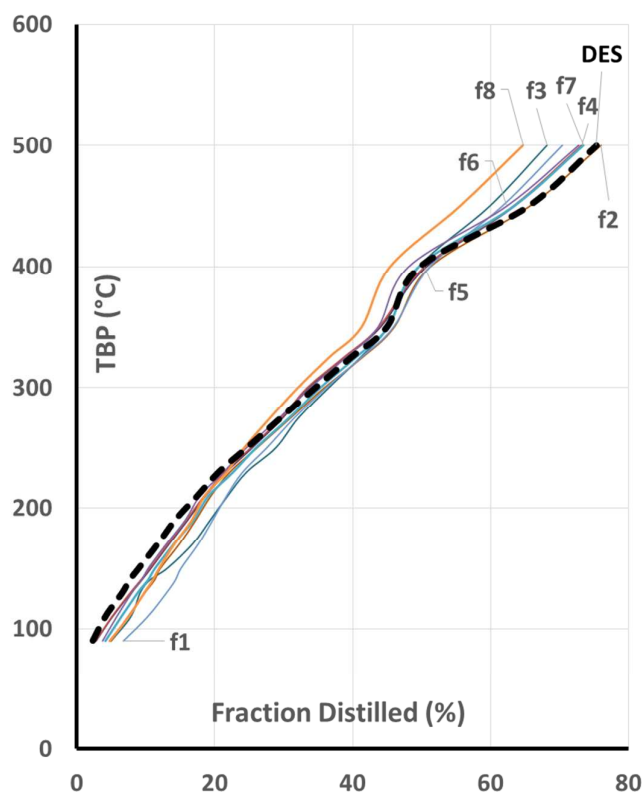


Figure S27. Best solution for CDU₁ at Example 9 using the sequential approach

Table S85. MCOBS schedule for CDU₂ at the best solution to Example 9 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	2.50	8.33	12.62	16.25	19.58	21.25	23.75
end time (day)		2.50	8.33	12.62	16.25	19.58	21.25	23.75	26.25
added tank in	p ₁	tk ₁	tk ₄₀	tk ₁₈	tk ₁₁	tk ₂₃	tk ₁₀	tk ₁₉	tk ₄₁
	p ₂	tk ₃₁	tk ₇	tk ₂₉	-	tk ₃₅	tk ₂₇	tk ₂	tk ₃₂
tank sequence in	p ₁	tk ₁	tk ₄₀	tk ₁₈	tk ₁₁	tk ₂₃	tk ₁₀	tk ₁₉	tk ₄₁
	p ₂	tk ₃₁	tk ₇	tk ₂₉	tk ₂₉	tk ₃₅	tk ₂₇	tk ₂	tk ₃₂
emptied tank in	p ₁	tk ₁	tk ₄₀	tk ₁₈	tk ₁₁	tk ₂₃	tk ₁₀	tk ₁₉	tk ₄₁
	p ₂	tk ₃₁	tk ₇	-	tk ₂₉	tk ₃₅	tk ₂₇	tk ₂	tk ₃₂
crude oil in	p ₁	cr ₁	cr ₇	cr ₈	cr ₄	cr ₄	cr ₄	cr ₈	cr ₈
	p ₂	cr ₁	cr ₃	cr ₆	cr ₆	cr ₃	cr ₃	cr ₁	cr ₁
flow rate in (m ³ /h)	p ₁	333.3	142.9	194.6	286.6	250.0	250.0	166.7	166.7
	p ₂	166.7	357.1	305.4	213.4	250.0	250.0	333.3	333.3
batch size (m ³)	p ₁	20,000	20,000	20,000	25,000	20,000	10,000	10,000	10,000
	p ₂	10,000	50,000	31,390	18,610	20,000	10,000	20,000	20,000
sulfur (ppm)		430	878	1576	2495	1814	1814	569	569

Table S86. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 9

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	2.34	3.59	3.23	2.67	2.47	2.47	3.91	3.91	2.35
90-110	1.57	1.76	1.86	2.35	2.04	2.04	2.41	2.41	1.83
110-130	2.50	2.01	0.82	2.24	2.46	2.46	2.35	2.35	2.50
130-140	1.51	1.21	0.81	1.08	1.39	1.39	1.68	1.68	1.01
140-150	1.16	0.78	1.54	1.13	1.24	1.24	2.05	2.05	1.36
150-170	2.56	2.48	2.26	1.91	2.51	2.51	3.47	3.47	2.72
170-190	2.45	2.19	1.72	2.07	2.53	2.53	2.81	2.81	2.53
190-210	2.20	2.04	1.78	2.12	2.45	2.45	2.60	2.60	3.19
210-230	2.34	2.68	2.02	2.39	2.96	2.96	2.80	2.80	3.13
230-250	3.28	3.69	2.97	2.85	3.65	3.65	4.09	4.09	4.06
250-275	4.74	4.86	2.81	3.33	4.48	4.48	4.46	4.46	4.93
275-300	4.66	4.62	3.75	3.16	3.80	3.80	4.80	4.80	4.98
300-325	4.34	5.41	4.22	4.63	5.27	5.27	4.57	4.57	5.15
325-350	4.54	4.61	4.20	5.11	5.05	5.05	4.29	4.29	5.22
350-400	6.85	4.98	4.23	6.29	6.30	6.30	6.16	6.16	4.76
400-450	13.99	15.29	10.01	9.80	13.46	13.46	12.86	12.86	15.75
450-500	9.43	11.18	9.70	9.43	10.33	10.33	8.50	8.50	9.87
>500	28.59	26.08	40.40	36.53	27.40	27.40	25.30	25.30	23.77

Table S87. TBP data of the feedstocks for CDU₂ at the best solution to Example 9

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	2.34	3.59	3.23	2.67	2.47	2.47	3.91	3.91	2.35
110	3.91	5.35	5.02	5.02	4.52	4.52	6.32	6.32	4.18
130	6.41	7.36	5.91	7.26	6.98	6.98	8.67	8.67	6.68
140	7.92	8.57	6.72	8.34	8.37	8.37	10.35	10.35	7.69
150	9.08	9.35	8.26	9.46	9.61	9.61	12.41	12.41	9.05
170	11.64	11.83	10.52	11.37	12.12	12.12	15.88	15.88	11.77
190	14.09	14.02	12.24	13.44	14.66	14.66	18.69	18.69	14.30
210	16.29	16.07	14.02	15.56	17.11	17.11	21.29	21.29	17.49
230	18.63	18.75	16.05	17.95	20.07	20.07	24.09	24.09	20.62
250	21.91	22.44	19.02	20.80	23.72	23.72	28.18	28.18	24.68
275	26.65	27.30	21.83	24.14	28.21	28.21	32.63	32.63	29.61
300	31.31	31.92	25.58	27.30	32.01	32.01	37.43	37.43	34.59
325	35.65	37.34	29.80	31.93	37.28	37.28	42.00	42.00	39.74
350	40.19	41.95	34.00	37.04	42.33	42.33	46.29	46.29	44.96
400	47.04	46.93	38.23	43.33	48.64	48.64	52.45	52.45	49.72
450	61.03	62.22	48.24	53.13	62.10	62.10	65.31	65.31	65.47
500	70.46	73.41	57.94	62.56	72.43	72.43	73.81	73.81	75.34

Example 9 - Sequential Approach
TBP curves of the feedstocks for CDU-2
15 charging tanks , 8 feedstocks

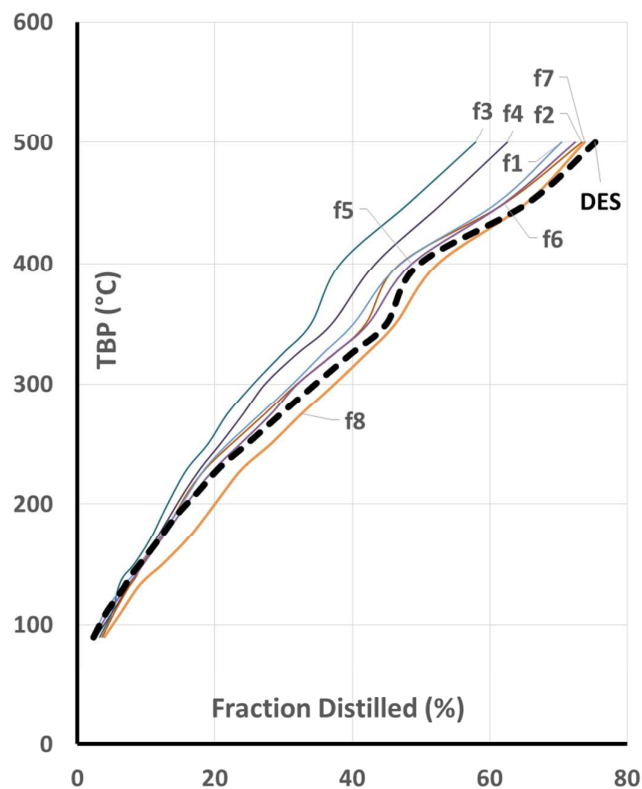


Figure S28. Best solution for CDU₂ at Example 9 using the sequential approach

Table S88. MCOBS schedule for CDU₃ at the best solution to Example 9 using 8 time slots

		Best feedstock sequence for CDU ₃							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.33	6.67	10.00	12.08	13.75	17.60	21.25
end time (day)		3.33	6.67	10.00	12.08	13.75	17.60	21.25	25.42
added tank in	p ₁	tk ₁₇	tk ₁₂	tk ₃₇	tk ₁₃	tk ₂₀	tk ₃₆	tk ₂₁	tk ₆
	p ₂	tk ₃₀	tk ₂₄	tk ₃	tk ₄	tk ₄₃	tk ₂₅	-	tk ₃₈
tank sequence in	p ₁	tk ₁₇	tk ₁₂	tk ₃₇	tk ₁₃	tk ₂₀	tk ₃₆	tk ₂₁	tk ₆
	p ₂	tk ₃₀	tk ₂₄	tk ₃	tk ₄	tk ₄₃	tk ₂₅	tk ₂₅	tk ₃₈
emptied tank in	p ₁	tk ₁₇	tk ₁₂	tk ₃₇	tk ₁₃	tk ₂₀	tk ₃₆	tk ₂₁	tk ₆
	p ₂	tk ₃₀	tk ₂₄	tk ₃	tk ₄	tk ₄₃	-	tk ₂₅	tk ₃₈
crude oil in	p ₁	cr ₈	cr ₅	cr ₅	cr ₅	cr ₄	cr ₄	cr ₄	cr ₂
	p ₂	cr ₆	cr ₉	cr ₁	cr ₁	cr ₉	cr ₉	cr ₉	cr ₆
flow rate in	p ₁	250.0	250.0	125.0	200.0	250.0	216.6	228.2	300.0
(m ³ /h)	p ₂	250.0	250.0	375.0	300.0	250.0	283.4	271.8	200.0
batch size	p ₁	20,000	20,000	10,000	10,000	10,000	20,000	20,000	30,000
(m ³)	p ₂	20,000	20,000	30,000	15,000	10,000	26,171	23,829	20,000
sulfur (ppm)		1444	2256	1313	1842	1693	1540	1593	1727

Table S89. Microcut yields in the feedstocks for CDU₃ at the best solution to Example 9

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₃ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	3.92	1.98	2.47	2.56	2.57	2.37	2.44	4.76	2.35
90-110	2.26	1.96	1.88	2.07	2.44	2.26	2.32	2.78	1.83
110-130	1.04	1.99	2.47	2.45	2.74	2.59	2.64	2.30	2.50
130-140	1.03	1.27	1.54	1.57	1.37	1.31	1.33	1.17	1.01
140-150	1.95	1.04	1.19	1.21	1.36	1.28	1.31	0.96	1.36
150-170	2.81	2.22	2.53	2.52	2.53	2.46	2.49	2.20	2.72
170-190	2.04	2.30	2.49	2.52	2.58	2.50	2.53	2.52	2.53
190-210	2.07	2.50	2.32	2.39	2.74	2.69	2.70	1.85	3.19
210-230	2.33	2.67	2.54	2.66	2.83	2.75	2.77	3.24	3.13
230-250	3.47	3.12	3.25	3.23	3.57	3.51	3.53	2.50	4.06
250-275	3.00	5.75	5.45	5.87	4.08	4.06	4.07	3.78	4.93
275-300	3.99	5.63	5.06	5.30	4.17	4.28	4.24	3.99	4.98
300-325	4.36	4.24	4.32	4.31	4.77	4.70	4.72	4.52	5.15
325-350	4.13	6.27	5.51	6.13	4.81	4.71	4.74	4.74	5.22
350-400	4.32	8.55	8.22	9.04	6.43	6.21	6.29	4.13	4.76
400-450	10.12	11.19	13.50	13.21	10.14	10.17	10.16	10.24	15.75
450-500	9.14	8.89	8.98	8.72	8.95	9.11	9.06	9.02	9.87
>500	36.47	28.35	25.33	23.38	32.24	33.43	33.02	33.92	23.77

Table S90. TBP data of the feedstocks for CDU₃ at the best solution to Example 9

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₃ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	3.92	1.98	2.47	2.56	2.57	2.37	2.44	4.76	2.35
110	6.19	3.94	4.36	4.63	5.01	4.63	4.76	7.54	4.18
130	7.23	5.93	6.83	7.08	7.75	7.22	7.40	9.84	6.68
140	8.26	7.20	8.37	8.64	9.12	8.53	8.74	11.01	7.69
150	10.22	8.24	9.56	9.85	10.48	9.82	10.05	11.97	9.05
170	13.03	10.46	12.09	12.37	13.02	12.28	12.53	14.17	11.77
190	15.08	12.77	14.59	14.89	15.60	14.78	15.07	16.69	14.30
210	17.15	15.27	16.91	17.28	18.34	17.47	17.77	18.54	17.49
230	19.48	17.95	19.45	19.94	21.17	20.21	20.55	21.78	20.62
250	22.95	21.07	22.70	23.17	24.75	23.72	24.08	24.28	24.68
275	25.96	26.82	28.15	29.05	28.83	27.79	28.15	28.06	29.61
300	29.95	32.45	33.21	34.35	33.00	32.07	32.39	32.05	34.59
325	34.31	36.69	37.53	38.66	37.77	36.76	37.11	36.56	39.74
350	38.44	42.97	43.06	44.79	42.58	41.47	41.86	41.30	44.96
400	42.77	51.52	51.28	53.83	49.01	47.68	48.14	45.43	49.72
450	52.89	62.71	64.78	67.03	59.15	57.85	58.30	55.57	65.47
500	62.03	71.60	73.77	75.75	68.11	66.96	67.36	64.69	75.34

Example 9 - Sequential Approach
TBP curves of the feedstocks for CDU-3
15 charging tanks, 8 feedstocks

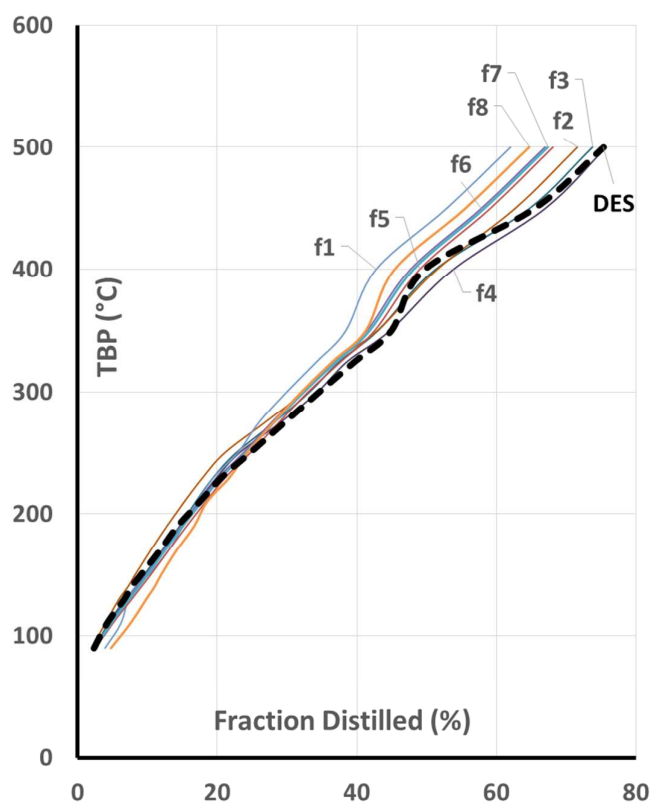


Figure S29. Best solution for CDU₃ at Example 9 using the sequential approach

II.9 Detailed results for Example 10 using the sequential approach

Table S91. MCOBS schedule for CDU₁ at the best solution to Example 10 using time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.33	7.50	10.00	12.50	14.17	17.98	22.92
end time (day)		3.33	7.50	10.00	12.50	14.17	17.98	22.92	27.08
added tank in	p ₁	tk ₄₀	tk ₄₇	tk ₁	tk ₅₇	tk ₂₀	tk ₁₁	tk ₃₃	tk ₁₇
	p ₂	tk ₃₉	tk ₂₆	tk ₃₇	tk ₄₃	tk ₄₈	tk ₅₀	-	tk ₅₄
tank sequence in	p ₁	tk ₄₀	tk ₄₇	tk ₁	tk ₅₇	tk ₂₀	tk ₁₁	tk ₃₃	tk ₁₇
	p ₂	tk ₃₉	tk ₂₆	tk ₃₇	tk ₄₃	tk ₄₈	tk ₅₀	tk ₅₀	tk ₅₄
emptied tank in	p ₁	tk ₄₀	tk ₄₇	tk ₁	tk ₅₇	tk ₂₀	tk ₁₁	tk ₃₃	tk ₁₇
	p ₂	tk ₃₉	tk ₂₆	tk ₃₇	tk ₄₃	tk ₄₈	-	tk ₅₀	tk ₅₄
crude oil in	p ₁	cr ₇	cr ₁₀	cr ₁	cr ₁₃	cr ₄	cr ₄	cr ₂	cr ₈
	p ₂	cr ₆	cr ₃	cr ₅	cr ₉	cr ₁₁	cr ₁₁	cr ₁₁	cr ₁₂
flow rate in (m ³ /h)	p ₁	250.0	300.0	333.3	333.3	250.0	272.8	253.4	200.0
	p ₂	250.0	200.0	166.7	166.7	250.0	227.2	246.6	300.0
batch size (m ³)	p ₁	20,000	30,000	20,000	20,000	10,000	25,000	30,000	20,000
	p ₂	20,000	20,000	10,000	10,000	10,000	20,813	29,187	30,000
sulfur (ppm)		1564	1908	1607	1384	2467	2500	1805	867

Table S92. Microcut yields in the feedstocks for CDU₁ at the best solution to Example 10

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	5.57	2.91	2.52	2.56	2.45	2.60	4.17	3.85	3.47
90-110	2.91	1.89	1.99	1.87	2.07	2.23	2.38	2.44	2.26
110-130	2.23	2.31	2.46	2.42	2.21	2.36	2.20	2.05	2.26
130-140	0.98	1.40	1.56	1.37	1.17	1.23	1.21	1.53	1.31
140-150	0.69	1.04	1.20	1.11	1.12	1.19	0.95	2.12	1.20
150-170	2.06	2.58	2.52	2.52	2.10	2.19	2.31	3.49	2.52
170-190	1.77	2.63	2.51	2.52	2.20	2.29	2.54	2.74	2.42
190-210	1.75	2.14	2.36	2.31	2.20	2.29	1.93	2.72	2.22
210-230	2.09	3.11	2.61	2.37	2.58	2.66	3.26	2.85	2.76
230-250	3.02	3.28	3.24	3.22	3.15	3.23	2.80	4.20	3.30
250-275	3.65	4.78	5.68	4.50	3.83	3.87	4.16	4.15	4.30
275-300	4.22	4.51	5.20	4.78	3.46	3.45	4.15	4.93	4.36
300-325	4.80	4.90	4.31	4.41	4.89	4.93	4.76	4.58	4.73
325-350	4.65	4.65	5.87	4.44	5.04	5.09	4.71	4.09	4.75
350-400	4.99	5.15	8.67	5.73	6.14	6.32	4.26	5.40	5.62
400-450	10.32	14.19	13.34	12.22	11.62	11.47	11.96	11.55	12.07
450-500	9.29	10.16	8.84	9.30	10.02	9.82	9.74	8.52	9.47
>500	33.45	27.26	24.25	31.40	33.09	32.20	31.45	28.40	30.15

Table S93. TBP data of the feedstocks for CDU₁ at the best solution to Example 10

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	5.57	2.91	2.52	2.56	2.45	2.60	4.17	3.85	3.47
110	8.48	4.80	4.51	4.43	4.53	4.83	6.55	6.29	5.73
130	10.71	7.11	6.97	6.86	6.74	7.19	8.85	8.34	7.99
140	11.69	8.51	8.52	8.28	7.91	8.43	9.96	9.87	9.30
150	12.39	9.55	9.72	9.33	9.03	9.62	10.91	11.99	10.50
170	14.45	12.13	12.25	11.85	11.13	11.81	13.22	15.48	13.02
190	16.22	14.76	14.76	14.37	13.34	14.11	15.76	18.22	15.44
210	17.97	16.90	17.11	16.68	15.54	16.40	17.69	20.95	17.66
230	20.06	20.02	19.72	19.05	18.12	19.06	20.95	23.79	20.42
250	23.08	23.30	22.96	22.27	21.27	22.29	23.75	27.99	23.72
275	26.74	28.08	28.65	26.77	25.10	26.16	27.91	32.14	28.02
300	30.96	32.58	33.84	31.55	28.57	29.62	32.06	37.07	32.38
325	35.77	37.49	38.16	35.96	33.46	34.55	36.83	41.65	37.11
350	40.42	42.13	44.02	40.40	38.50	39.64	41.53	45.74	41.86
400	45.42	47.29	52.70	46.13	44.65	45.96	45.79	51.14	47.48
450	55.74	61.48	66.03	58.35	56.27	57.43	57.75	62.69	59.55
500	65.04	71.64	74.87	67.66	66.29	67.25	67.49	71.21	69.02

Example 10 - Sequential Approach
TBP curves of the feedstocks for CDU-1
(15 charging tanks, 8 feedstocks)

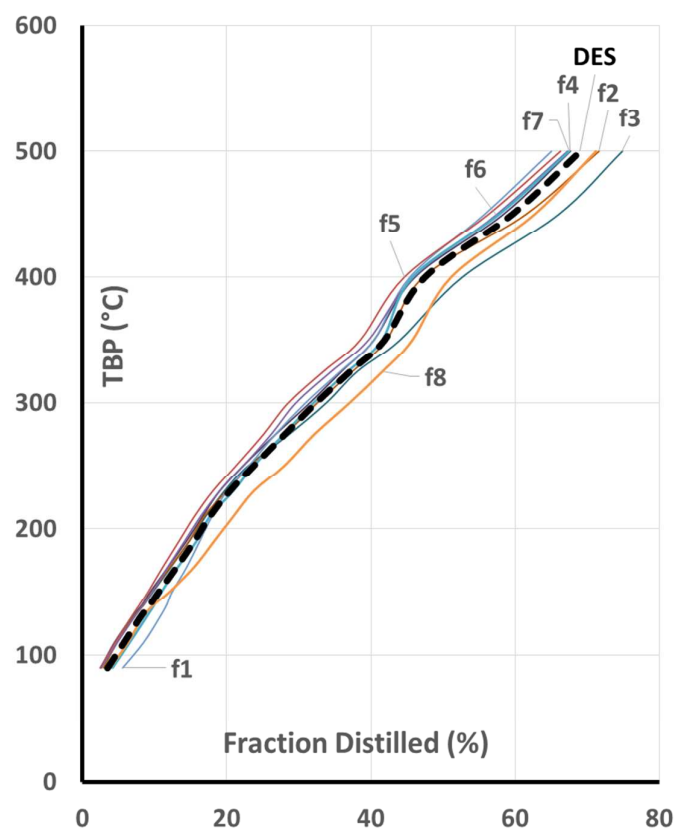


Figure S30. Best solution for CDU₁ at Example 10 using the sequential approach

Table S94. MCOBS schedule for CDU₂ at the best solution to Example 10 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.33	6.45	8.33	10.00	16.67	19.17	21.67
end time (day)		3.33	6.45	8.33	10.00	16.67	19.17	21.67	25.83
added tank in	p ₁	tk ₅	tk ₂₁	tk ₁₉	tk ₂₂	tk ₆	tk ₃₄	tk ₄₁	tk ₄₆
	p ₂	tk ₃₈	tk ₁₄	-	tk ₅₅	tk ₇	tk ₂₄	tk ₂	tk ₅₆
tank sequence in	p ₁	tk ₅	tk ₂₁	tk ₁₉	tk ₂₂	tk ₆	tk ₃₄	tk ₄₁	tk ₄₆
	p ₂	tk ₃₈	tk ₁₄	tk ₁₄	tk ₅₅	tk ₇	tk ₂₄	tk ₂	tk ₅₆
emptied tank in	p ₁	tk ₅	tk ₂₁	tk ₁₉	tk ₂₂	tk ₆	tk ₃₄	tk ₄₁	tk ₄₆
	p ₂	tk ₃₈	-	tk ₁₄	tk ₅₅	tk ₇	tk ₂₄	tk ₂	tk ₅₆
crude oil in	p ₁	cr ₂	cr ₄	cr ₈	cr ₄	cr ₂	cr ₂	cr ₈	cr ₁₀
	p ₂	cr ₆	cr ₆	cr ₆	cr ₁₃	cr ₃	cr ₉	cr ₁	cr ₁₃
flow rate in	p ₁	250.0	267.2	221.5	250.0	187.5	166.7	166.7	200.0
(m ³ /h)	p ₂	250.0	232.8	278.5	250.0	312.5	333.3	333.3	300.0
batch size	p ₁	20,000	20,000	10,000	10,000	30,000	10,000	10,000	20,000
(m ³)	p ₂	20,000	17,424	12,576	10,000	50,000	20,000	20,000	30,000
sulfur (ppm)		1779	2464	1512	2317	1066	874	569	2140

Table S95. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 10

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.10	2.54	3.57	3.68	3.33	3.19	3.91	3.68	3.47
90-110	2.38	2.22	2.06	3.02	1.82	2.18	2.41	2.54	2.26
110-130	1.92	2.09	0.93	3.35	2.08	2.34	2.35	2.96	2.26
130-140	0.98	1.01	0.92	1.73	1.30	1.24	1.68	1.65	1.31
140-150	0.81	1.06	1.74	1.59	0.93	1.05	2.05	1.30	1.20
150-170	1.89	1.80	2.43	2.93	2.51	2.48	347	2.87	2.52
170-190	2.19	1.97	1.88	2.99	2.61	2.59	2.81	2.93	2.42
190-210	1.66	2.03	1.92	2.72	2.07	2.42	2.60	2.34	2.22
210-230	2.86	2.29	2.17	2.95	3.33	3.06	2.80	2.89	2.76
230-250	2.29	2.74	3.21	3.67	3.28	3.18	4.09	3.30	3.30
250-275	3.50	3.25	2.90	4.51	4.79	4.25	4.46	4.79	4.30
275-300	3.81	3.14	3.87	4.01	4.42	4.90	4.80	4.67	4.36
300-325	4.38	4.57	4.29	4.91	5.16	4.50	4.57	4.58	4.73
325-350	4.69	5.06	4.17	5.11	4.67	4.33	4.29	4.68	4.75
350-400	4.09	6.12	4.27	7.14	4.44	4.62	6.16	5.95	5.62
400-450	10.14	9.79	10.06	11.54	14.62	10.45	12.86	12.82	12.07
450-500	9.46	9.58	9.43	8.33	10.78	9.18	8.50	8.67	9.47
>500	37.30	37.73	38.49	24.94	27.29	34.21	25.30	25.71	30.15

Table S96. TBP data of the feedstocks for CDU₂ at the best solution to Example 10

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.10	2.54	3.57	3.68	3.33	3.19	3.91	3.68	3.47
110	6.48	4.76	5.62	6.70	5.15	5.37	6.32	6.22	5.73
130	8.41	6.85	6.55	10.05	7.23	7.71	8.67	9.17	7.99
140	9.39	7.86	7.47	11.78	8.53	8.94	10.35	10.83	9.30
150	10.20	8.92	9.21	13.37	9.47	10.00	12.41	12.13	10.50
170	12.09	10.72	11.74	16.30	11.98	12.47	15.88	15.00	13.02
190	14.28	12.69	13.62	19.29	14.59	15.07	18.69	17.92	15.44
210	15.95	14.71	15.54	22.01	16.66	17.49	21.29	20.26	17.66
230	18.81	17.00	17.71	24.97	19.99	20.54	24.09	23.15	20.42
250	21.10	19.75	20.93	28.64	23.27	23.72	28.18	26.45	23.72
275	24.60	23.00	23.83	33.15	28.05	27.97	32.63	31.24	28.02
300	28.41	26.14	27.70	37.16	32.48	32.86	37.43	35.91	32.38
325	32.79	30.71	31.99	42.08	37.63	37.36	42.00	40.49	37.11
350	37.48	35.78	36.16	47.19	42.30	41.69	46.29	45.17	41.86
400	41.57	41.90	40.43	54.34	46.75	46.31	52.45	51.12	47.48
450	51.71	51.69	50.50	65.88	61.37	56.76	65.31	63.95	59.55
500	61.17	61.28	59.93	74.22	72.14	65.93	73.81	72.62	69.02

Example 10 - Sequential Approach
TBP curves of the feedstocks for CDU-2
15 charging tanks, 8 feedstocks

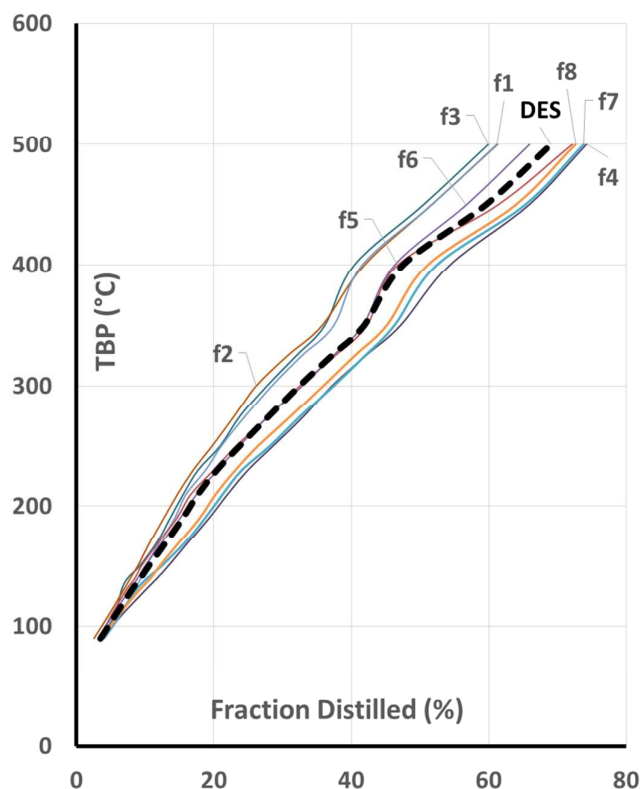


Figure S31. Best solution for CDU₂ at Example 10 using the sequential approach

Table S97. MCOBS schedule for CDU₃ at the best solution to Example 10 using 8 time slots

		Best feedstock sequence for CDU ₃							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	5.00	6.67	9.58	12.92	16.25	18.75	22.08
end time (day)		5.00	6.67	9.58	12.92	16.25	18.75	22.08	27.92
added tank in	p ₁	tk ₁₆	-	tk ₁₂	tk ₃₆	tk ₂₃	tk ₁₀	tk ₃	tk ₄₂
	p ₂	tk ₃₀	tk ₂₈	tk ₄	tk ₃₅	tk ₄₉	tk ₄₅	tk ₂₇	tk ₂₅
tank sequence in	p ₁	tk ₁₆	tk ₁₆	tk ₁₂	tk ₃₆	tk ₂₃	tk ₁₀	tk ₃	tk ₄₂
	p ₂	tk ₃₀	tk ₂₈	tk ₄	tk ₃₅	tk ₄₉	tk ₄₅	tk ₂₇	tk ₂₅
emptied tank in	p ₁	-	tk ₁₆	tk ₁₂	tk ₃₆	tk ₂₃	tk ₁₀	tk ₃	tk ₄₂
	p ₂	tk ₃₀	tk ₂₈	tk ₄	tk ₃₅	tk ₄₉	tk ₄₅	tk ₂₇	tk ₂₅
crude oil in	p ₁	cr ₇	cr ₇	cr ₅	cr ₄	cr ₄	cr ₄	cr ₁	cr ₈
	p ₂	cr ₆	cr ₆	cr ₁	cr ₃	cr ₁₁	cr ₃	cr ₃	cr ₉
flow rate in	p ₁	333.3	250.0	285.7	250.0	250.0	166.7	375.0	142.9
(m ³ /h)	p ₂	166.7	250.0	214.3	250.0	250.0	333.3	125.0	357.1
batch size	p ₁	40,000	10,000	20,000	20,000	20,000	10,000	30,000	20,000
(m ³)	p ₂	20,000	10,000	15,000	20,000	20,000	20,000	10,000	50,000
sulfur (ppm)		1405	1564	2447	1814	2467	1474	521	637

Table S98. Microcut yields in the feedstocks for CDU₃ at the best solution to Example 10

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₃ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	7.16	5.57	2.65	2.47	2.45	1.95	1.98	2.79	3.47
90-110	3.74	2.91	2.29	2.04	2.07	1.47	1.25	1.96	2.26
110-130	2.96	2.23	2.43	2.46	2.21	1.99	2.14	1.73	2.26
130-140	1.30	0.98	1.59	1.39	1.17	1.23	1.36	1.22	1.31
140-150	0.90	0.69	1.23	1.24	1.12	1.01	1.01	1.67	1.20
150-170	2.64	2.06	2.50	2.51	2.10	2.33	2.41	2.94	2.52
170-190	2.17	1.77	2.55	2.53	2.20	2.32	2.31	2.42	2.42
190-210	2.08	1.75	2.47	2.45	2.20	2.23	2.09	2.64	2.22
210-230	2.47	2.09	2.80	2.96	2.58	2.79	2.37	2.63	2.76
230-250	3.62	3.02	3.21	3.65	3.15	3.51	3.27	3.84	3.30
250-275	4.17	3.65	6.36	4.48	3.83	4.57	4.74	3.92	4.30
275-300	4.66	4.22	5.58	3.80	3.46	3.95	4.56	5.01	4.36
300-325	5.17	4.80	4.29	5.27	4.89	5.25	4.56	4.45	4.73
325-350	4.72	4.65	6.81	5.05	5.04	4.88	4.53	3.96	4.75
350-400	5.37	4.99	9.98	6.30	6.14	5.71	6.27	4.78	5.62
400-450	10.56	10.32	12.87	13.46	11.62	14.64	14.74	10.42	12.07
450-500	8.51	9.30	8.41	10.33	10.02	11.18	10.29	9.13	9.47
>500	26.53	33.45	21.15	27.40	33.09	28.75	29.30	34.73	30.15

Table S99. TBP data of the feedstocks for CDU₃ at the best solution to Example 10

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₃ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	7.16	5.57	2.65	2.47	2.45	1.95	1.98	2.79	3.47
110	10.90	8.48	4.94	4.52	4.53	3.41	3.23	4.74	5.73
130	13.86	10.71	7.36	6.98	6.74	5.40	5.37	6.48	7.99
140	15.16	11.69	8.95	8.37	7.91	6.64	6.73	7.69	9.30
150	16.06	12.39	10.18	9.61	9.03	7.65	7.74	9.36	10.50
170	18.70	14.45	12.68	12.12	11.13	9.98	10.15	12.30	13.02
190	20.88	16.22	15.23	14.66	13.34	12.29	12.46	14.72	15.44
210	22.96	17.97	17.70	17.11	15.54	14.52	14.55	17.36	17.66
230	25.43	20.06	20.50	20.07	18.12	17.31	16.92	19.99	20.42
250	29.05	23.08	23.72	23.72	21.27	20.83	20.19	23.83	23.72
275	33.21	26.73	30.07	28.21	25.10	25.39	24.93	27.75	28.02
300	37.88	30.96	35.65	32.01	28.57	29.43	29.48	32.76	32.38
325	43.05	35.76	39.94	37.28	33.46	34.60	34.04	37.21	37.11
350	47.77	40.42	46.76	42.33	38.50	39.47	38.58	41.18	41.86
400	53.13	45.41	56.74	48.64	44.65	45.19	44.85	45.95	47.48
450	63.69	55.74	69.61	62.10	56.27	59.83	59.59	56.38	59.55
500	72.20	65.03	78.02	72.43	66.29	71.01	69.88	65.51	69.02

Example 10 - Sequential Approach
TBP curves of the feedstocks for CDU-3
15 charging tanks, 8 feedstocks

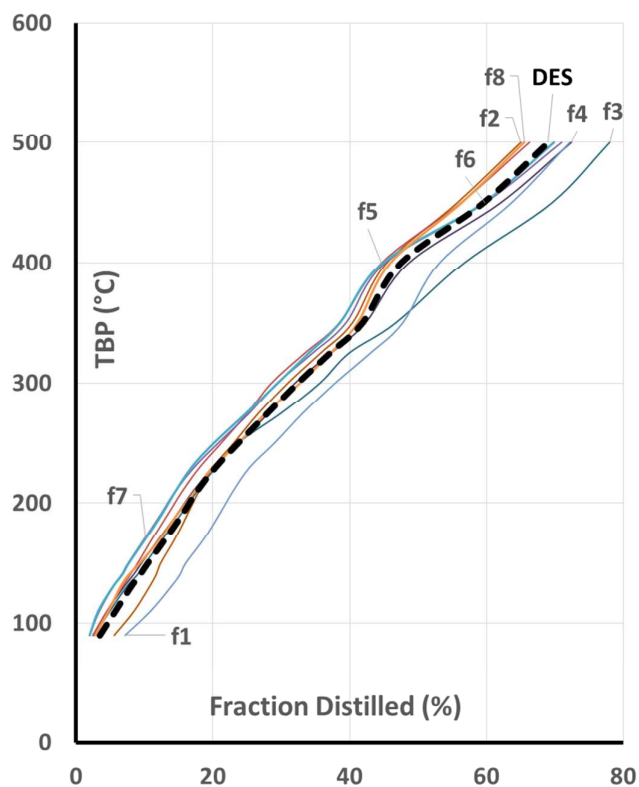


Figure S32. Best solution for CDU₃ at Example 10 using the sequential approach

Table S100. MCOBS schedule for CDU₄ at the best solution to Example 10 using 8 time slots

		Best feedstock sequence for CDU ₄							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	1.67	3.75	7.08	10.00	15.69	20.00	22.50
end time (day)		1.67	3.75	7.08	10.00	15.69	20.00	22.50	25.83
added tank in	p ₁	tk ₃₁	tk ₅₉	tk ₅₈	tk ₁₅	tk ₆₀	tk ₉	tk ₁₃	tk ₁₈
	p ₂	tk ₅₁	tk ₅₂	tk ₅₃	tk ₈	tk ₂₉	-	tk ₃₂	tk ₄₄
tank sequence in	p ₁	tk ₃₁	tk ₅₉	tk ₅₈	tk ₁₅	tk ₆₀	tk ₉	tk ₁₃	tk ₁₈
	p ₂	tk ₅₁	tk ₅₂	tk ₅₃	tk ₈	tk ₂₉	tk ₂₉	tk ₃₂	tk ₄₄
emptied tank in	p ₁	tk ₃₁	tk ₅₉	tk ₅₈	tk ₁₅	tk ₆₀	tk ₉	tk ₁₃	tk ₁₈
	p ₂	tk ₅₁	tk ₅₂	tk ₅₃	tk ₈	-	tk ₂₉	tk ₃₂	tk ₄₄
crude oil in	p ₁	cr ₁	cr ₁₄	cr ₁₄	cr ₇	cr ₁₄	cr ₄	cr ₅	cr ₈
	p ₂	cr ₁₂	cr ₁₂	cr ₁₂	cr ₃	cr ₆	cr ₆	cr ₁	cr ₃
flow rate in	p ₁	250.0	200.0	250.0	214.3	292.9	290.0	166.7	250.0
(m ³ /h)	p ₂	250.0	300.0	250.0	285.7	207.1	210.0	333.3	250.0
batch size	p ₁	10,000	10,000	20,000	15,000	40,000	30,000	10,000	20,000
(m ³)	p ₂	10,000	15,000	20,000	20,000	28,283	21,717	20,000	20,000
sulfur (ppm)		655	1448	1590	920	2192	2500	1607	821

Table S101. Microcut yields in the feedstocks for CDU₄ at the best solution to Example 10

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₄ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	2.02	3.35	3.76	4.94	3.74	2.69	2.52	3.97	3.47
90-110	1.45	2.26	2.49	2.49	2.32	2.37	1.99	2.20	2.26
110-130	2.27	2.62	2.76	2.49	2.05	2.27	2.46	1.54	2.26
130-140	1.35	1.45	1.51	1.35	1.08	1.09	1.56	1.47	1.31
140-150	1.07	1.17	1.22	0.89	0.88	1.14	1.20	2.20	1.20
150-170	2.42	2.66	2.75	2.74	2.03	1.92	2.52	3.62	2.52
170-190	2.33	2.72	2.85	2.35	2.27	2.09	2.51	2.70	2.42
190-210	2.23	2.35	2.37	2.19	1.76	2.14	2.36	2.58	2.22
210-230	2.30	3.03	3.21	2.79	2.83	2.41	2.61	3.08	2.76
230-250	3.23	3.25	3.26	3.91	2.46	2.87	3.24	4.47	3.30
250-275	4.53	4.54	4.59	4.93	3.72	3.35	5.68	4.31	4.30
275-300	4.74	4.77	4.76	4.80	3.95	3.16	5.20	4.66	4.36
300-325	4.31	4.52	4.57	5.51	4.39	4.64	4.31	5.12	4.73
325-350	4.41	4.51	4.56	4.66	4.68	5.11	5.87	4.16	4.75
350-400	6.33	5.46	5.37	5.21	4.49	6.32	8.67	4.65	5.62
400-450	13.08	11.89	11.82	14.44	10.72	9.80	13.34	13.80	12.07
450-500	9.60	8.99	8.79	10.33	9.40	9.40	8.84	9.76	9.47
>500	31.72	29.89	28.64	23.40	35.60	36.32	24.25	25.08	30.15

Table S102. TBP data of the feedstocks for CDU₄ at the best solution to Example 10

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₄ (%)								$cydref_{mc}$
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	2.02	3.35	3.76	4.94	3.74	2.69	2.52	3.97	3.47
110	3.48	5.62	6.26	7.43	6.06	5.06	4.51	6.17	5.73
130	5.75	8.24	9.20	9.92	8.11	7.33	6.97	7.72	7.99
140	7.11	9.69	10.53	11.27	9.19	8.42	8.52	9.19	9.30
150	8.18	10.86	11.75	12.16	10.08	9.56	9.72	11.39	10.50
170	10.60	13.52	14.51	14.90	12.11	11.49	12.25	15.02	13.02
190	12.93	16.24	17.36	17.25	14.38	13.58	14.76	17.72	15.44
210	15.17	18.60	19.73	19.44	16.14	15.71	17.11	20.31	17.66
230	17.47	21.62	22.95	22.23	18.97	18.12	19.72	23.39	20.42
250	20.71	24.87	26.21	26.15	21.43	20.99	22.96	27.87	23.72
275	25.24	29.41	30.80	31.07	25.15	24.34	28.65	32.18	28.02
300	29.99	34.18	35.56	35.88	29.10	27.50	33.84	36.84	32.38
325	34.30	38.70	40.13	41.39	33.49	32.15	38.16	41.96	37.11
350	38.71	43.20	44.69	46.05	38.17	37.26	44.02	46.12	41.86
400	45.05	48.67	50.07	51.26	42.67	43.58	52.70	50.77	47.48
450	58.13	60.56	61.89	65.69	53.38	53.38	66.03	64.57	59.55
500	67.73	69.55	70.69	76.03	62.78	62.79	74.87	74.33	69.02

Example 10 - Sequential Approach
TBP curves of the feedstocks for CDU-4
15 charging tanks, 8 feedstocks

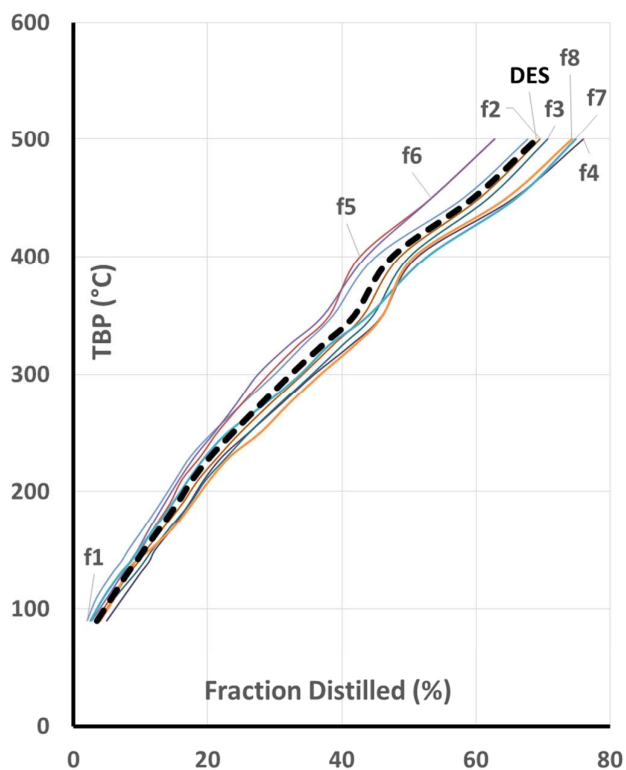


Figure S33. Best solution for CDU₄ at Example 10 using the sequential approach

II.9 Detailed results for Example 11 using the sequential approach

Table S103. MCOBS schedule for CDU₁ at the best solution to Example 11 using 8 time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	5.00	6.67	9.17	11.67	15.00	17.50	21.25
end time (day)		5.00	6.67	9.17	11.67	15.00	17.50	21.25	24.58
added tank in	p ₁	tk ₁₅	tk ₂₂	tk ₂₀	tk ₁₁	tk ₆	tk ₅	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₁	tk ₄	tk ₂₉	-	tk ₂₄	tk ₂₇	tk ₁₇
tank sequence in	p ₁	tk ₆	tk ₅	tk ₅	tk ₃₇	tk ₅₆	tk ₃₆	tk ₁₁	tk ₄₂
	p ₂	tk ₁₄	tk ₄₈	tk ₅₃	tk ₃₂	tk ₄₃	tk ₂₇	tk ₄₅	tk ₄₉
emptied tank in	p ₁	tk ₁₅	tk ₂₂	tk ₂₀	tk ₁₁	tk ₆	tk ₅	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₁	tk ₄	-	tk ₂₉	tk ₂₄	tk ₂₇	tk ₁₇
crude oil in	p ₁	cr ₂	cr ₂	cr ₂	cr ₅	cr ₁₃	cr ₄	cr ₄	cr ₈
	p ₂	cr ₆	cr ₁₁	cr ₁₂	cr ₁	cr ₉	cr ₃	cr ₃	cr ₁₁
flow rate in	p ₁	250.0	250.5	166.3	166.7	375.0	333.3	277.8	250.0
(m ³ /h)	p ₂	250.0	249.5	333.7	333.3	125.0	166.7	222.2	250.0
batch size	p ₁	30,000	10,035	9,965	10,000	30,000	20,000	25,000	20,000
(m ³)	p ₂	30,000	10,000	20,000	20,000	10,000	10,000	20,000	20,000
sulfur (ppm)		1779	1808	1092	1607	1488	2153	1927	1474

Table S104. Microcut yields in the feedstocks for CDU₁ at the best solution to Example 11

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.10	4.13	3.60	2.52	2.74	3.00	2.65	3.95	3.55
90-110	2.38	2.36	2.34	1.99	1.97	2.62	2.24	2.23	2.36
110-130	1.92	2.18	2.63	2.46	2.52	2.93	2.62	1.29	2.29
130-140	0.98	1.21	1.44	1.56	1.43	1.55	1.44	1.25	1.30
140-150	0.81	0.94	1.17	1.20	1.14	1.47	1.32	2.08	1.25
150-170	1.89	2.29	2.67	2.52	2.58	2.70	2.58	3.21	2.53
170-190	2.19	2.52	2.75	2.51	2.59	2.74	2.61	2.37	2.39
190-210	1.66	1.92	2.37	2.36	2.31	2.68	2.53	2.33	2.28
210-230	2.86	3.24	3.10	2.61	2.39	3.13	3.02	2.71	2.72
230-250	2.29	2.80	3.24	3.24	3.24	3.79	3.70	3.97	3.39
250-275	3.50	4.15	4.51	5.68	4.57	4.40	4.46	3.65	4.26
275-300	3.81	4.15	4.79	5.20	4.75	3.65	3.75	4.32	4.30
300-325	4.38	4.76	4.54	4.31	4.44	5.29	5.28	4.74	4.77
325-350	4.69	4.70	4.50	5.87	4.49	5.23	5.11	4.14	4.84
350-400	4.09	4.25	5.31	8.67	5.85	6.90	6.50	4.49	5.88
400-450	10.14	11.98	11.6	13.34	12.46	12.29	13.07	11.96	11.77
450-500	9.46	9.77	8.94	8.84	9.20	9.48	10.05	9.45	9.38
>500	37.30	31.58	30.04	24.25	30.18	26.05	26.95	30.77	29.90

Table S105. TBP data of the feedstocks for CDU₁ at the best solution to Example 11

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.10	4.13	3.60	2.52	2.74	3.00	2.65	3.95	3.55
110	6.48	6.49	4.94	4.51	4.71	5.63	4.89	6.18	5.91
130	8.41	8.67	8.57	6.97	7.24	8.56	7.51	7.48	8.20
140	9.39	9.87	10.01	8.52	8.67	10.10	8.95	8.73	9.50
150	10.20	10.81	11.19	9.72	9.81	11.57	10.26	10.81	10.75
170	12.09	13.11	13.86	12.25	12.40	14.27	12.84	14.03	13.28
190	14.28	15.63	16.61	14.76	14.98	17.03	15.45	16.40	15.67
210	15.95	17.55	18.98	17.11	17.29	19.71	17.98	18.73	17.95
230	18.81	20.79	22.08	19.72	19.68	22.84	21.00	21.44	20.67
250	21.10	23.59	25.33	22.96	22.92	26.62	24.69	25.42	24.06
275	24.60	27.74	29.84	28.65	27.49	31.03	29.15	29.07	28.32
300	28.41	31.89	34.63	33.84	32.24	34.68	32.90	33.40	32.62
325	32.79	36.65	39.16	38.16	36.68	39.96	38.17	38.14	37.39
350	37.48	41.35	43.66	44.02	41.16	45.20	43.29	42.29	42.23
400	41.57	45.61	48.98	52.70	47.02	52.09	49.79	46.78	48.11
450	51.71	57.58	60.64	66.03	59.47	64.38	62.86	58.74	59.88
500	61.17	67.35	69.59	74.87	68.67	73.86	72.91	68.19	69.26

Example 11 - Sequential Approach
TBP curves of the feedstocks for CDU-1
15 charging tanks, 8 feedstocks

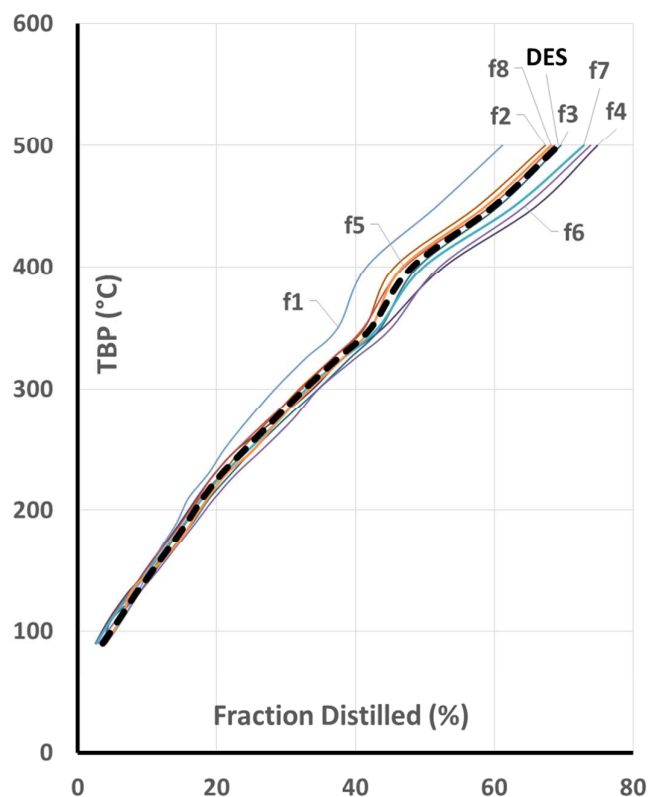


Figure S34. TBP curves of the feedstocks for CDU₁ at the best solution for Example 11

Table S106. MCOBS schedule for CDU₂ at the best solution to Example 11 using 9 time slots

		Best feedstock sequence for CDU ₂								
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉
start time (day)		0	3.33	6.67	10.00	11.44	16.68	20.00	22.08	25.42
end time (day)		3.33	6.67	10.00	11.44	16.68	20.00	22.08	25.42	28.75
added tank in	p ₁	tk ₄₀	tk ₅₈	tk ₁₂	tk ₂₂	tk ₆₀	tk ₁₈	tk ₂₀	tk ₂₃	tk ₁₉
	p ₂	tk ₃₀	tk ₃₅	tk ₁	tk ₂₉	-	-	tk ₅₂	tk ₄₄	tk ₃
tank sequence in	p ₁	tk ₄₀	tk ₅₈	tk ₁₂	tk ₂₂	tk ₆₀	tk ₁₈	tk ₂₀	tk ₂₃	tk ₁₉
	p ₂	tk ₃₀	tk ₃₅	tk ₁	tk ₂₉	tk ₂₉	tk ₂₉	tk ₅₂	tk ₄₄	tk ₃
emptied tank in	p ₁	tk ₄₀	tk ₅₈	tk ₁₂	tk ₂₂	tk ₆₀	tk ₁₈	tk ₂₀	tk ₂₃	tk ₁₉
	p ₂	tk ₃₀	tk ₃₅	tk ₁	-	-	tk ₂₉	tk ₅₂	tk ₄₄	tk ₃
crude oil in	p ₁	cr ₇	cr ₁₄	cr ₅	cr ₄	cr ₁₄	cr ₈	cr ₄	cr ₄	cr ₈
	p ₂	cr ₆	cr ₃	cr ₁	cr ₆	cr ₆	cr ₆	cr ₁₂	cr ₃	cr ₁
flow rate in	p ₁	250.0	250.0	250.0	290.0	317.8	251.0	200.0	250.0	125.0
(m ³ /h)	p ₂	250.0	250.0	250.0	210.0	182.2	249.0	300.0	250.0	375.0
batch size	p ₁	20,000	20,000	20,000	10,000	40,000	20,000	10,000	20,000	10,000
(m ³)	p ₂	20,000	20,000	20,000	7,239	22,928	19,833	15,000	20,000	30,000
sulfur (ppm)		1564	1547	2195	2500	2205	1442	1661	1814	535

Table S107. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 11

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)									Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
HK-90	5.57	3.35	2.61	2.69	3.99	3.94	2.65	2.47	3.52	3.55
90-110	2.91	1.98	2.20	2.37	2.48	2.27	2.32	2.04	2.20	2.36
110-130	2.23	2.26	2.43	2.27	2.22	1.05	2.78	2.46	2.38	2.29
130-140	0.98	1.37	1.58	1.09	1.17	1.03	1.46	1.39	1.64	1.30
140-150	0.69	1.01	1.22	1.14	0.95	1.96	1.36	1.24	1.83	1.25
150-170	2.06	2.59	2.50	1.92	2.17	2.82	2.60	2.51	3.24	2.53
170-190	1.77	2.68	2.54	2.09	2.42	2.05	2.61	2.53	2.72	2.39
190-210	1.75	2.12	2.43	2.14	1.85	2.08	2.62	2.45	2.50	2.28
210-230	2.09	3.31	2.74	2.41	2.99	2.34	2.75	2.96	2.68	2.72
230-250	3.02	3.28	3.22	2.87	2.56	3.48	3.54	3.65	3.89	3.39
250-275	3.65	4.79	6.15	3.35	3.85	3.01	4.29	4.48	4.53	4.26
275-300	4.22	4.47	5.46	3.16	4.04	3.99	4.24	3.80	4.76	4.30
300-325	4.80	5.04	4.30	4.64	4.45	4.37	4.70	5.27	4.51	4.77
325-350	4.65	4.67	6.53	5.11	4.69	4.13	4.81	5.05	4.35	4.84
350-400	4.99	4.73	9.58	6.32	4.55	4.33	6.72	6.30	6.33	5.88
400-450	10.32	14.24	13.01	9.80	10.81	10.12	11.27	13.46	13.14	11.77
450-500	9.29	10.34	8.54	9.40	9.21	9.13	8.98	10.33	8.73	9.38
>500	33.45	26.93	22.08	36.32	34.01	36.40	30.26	27.40	26.12	29.90

Table S108. TBP data of the feedstocks for CDU₂ at the best solution to Example 11

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)									<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
90	5.57	3.35	2.61	2.69	3.99	3.94	2.69	2.65	2.47	3.55
110	8.48	5.33	4.81	5.06	6.57	6.21	4.97	4.52	5.72	5.91
130	10.71	7.59	7.24	7.33	8.69	7.26	7.74	6.98	8.10	8.20
140	11.69	8.97	8.82	8.42	9.87	8.29	9.21	8.37	9.74	9.50
150	12.39	9.98	10.04	9.56	10.82	10.26	10.56	9.61	11.57	10.75
170	14.45	12.57	12.55	11.49	12.99	13.08	13.16	12.12	14.82	13.28
190	16.22	15.25	15.09	13.58	15.41	15.13	15.77	14.66	17.54	15.67
210	17.97	17.37	17.52	15.71	17.26	17.21	18.39	17.11	20.04	17.95
230	20.06	20.68	20.27	18.12	20.25	19.55	21.14	20.07	22.72	20.67
250	23.08	23.97	23.49	20.99	22.81	23.03	24.67	23.72	26.61	24.06
275	26.74	28.76	29.64	24.34	26.67	26.04	28.97	28.21	31.14	28.32
300	30.96	33.23	35.11	27.50	30.71	30.03	33.21	32.01	35.90	32.62
325	35.77	38.27	39.41	32.15	35.15	34.40	37.90	37.28	40.41	37.39
350	40.42	42.95	45.94	37.26	39.85	38.53	42.71	42.33	44.76	42.23
400	45.42	47.68	55.52	43.58	44.40	42.86	49.44	48.64	51.09	48.11
450	55.74	61.92	68.53	53.38	55.21	52.98	60.71	62.10	64.24	59.88
500	65.04	72.26	77.07	62.79	64.42	62.11	69.69	72.43	72.97	69.26

Example 11 - Sequential Approach
TBP curves of the feedstocks for CDU-2
16 charging tanks, 9 feedstocks

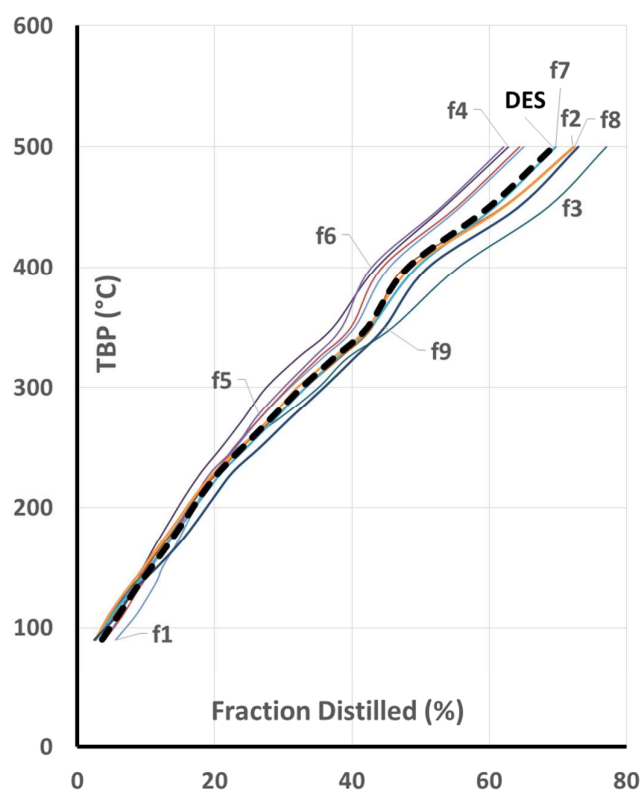


Figure S35. TBP curves of the feedstocks for CDU₂ at the best solution for Example 11

Table S109. MCOBS schedule for CDU₃ at the best solution to Example 11 using 9 time slots

		Best feedstock sequence for CDU ₃								
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉
start time (day)		0	4.96	6.67	10.00	11.67	13.75	15.62	19.58	25.42
end time (day)		4.96	6.67	10.00	11.67	13.75	15.62	19.58	25.42	28.75
added tank in	p ₁	tk ₁₆	-	tk ₄₇	tk ₅₉	tk ₃₁	tk ₁₀	tk ₄₁	tk ₄₆	tk ₃₄
	p ₂	tk ₃₈	tk ₂₈	tk ₈	-	tk ₄	tk ₇	-	tk ₂₅	tk ₅₄
tank sequence in	p ₁	tk ₁₆	tk ₁₆	tk ₄₇	tk ₅₉	tk ₃₁	tk ₁₀	tk ₄₁	tk ₄₆	tk ₃₄
	p ₂	tk ₃₈	tk ₂₈	tk ₈	tk ₈	tk ₄	tk ₇	tk ₇	tk ₂₅	tk ₅₄
emptied tank in	p ₁	-	tk ₁₆	tk ₄₇	tk ₅₉	tk ₃₁	tk ₁₀	tk ₄₁	tk ₄₆	tk ₃₄
	p ₂	tk ₃₈	tk ₂₈	-	tk ₈	tk ₄	-	tk ₇	tk ₂₅	tk ₅₄
crude oil in	p ₁	cr ₇	cr ₇	cr ₁₀	cr ₁₄	cr ₁	cr ₄	cr ₈	cr ₁₀	cr ₂
	p ₂	cr ₆	cr ₆	cr ₃	cr ₃	cr ₁	cr ₃	cr ₃	cr ₉	cr ₁₂
flow rate in	p ₁	332.0	255.7	375.0	250.0	200.0	222.8	105.1	142.9	125.0
(m ³ /h)	p ₂	168.0	244.3	125.0	250.0	300.0	277.2	394.9	357.1	375.0
batch size	p ₁	39,535	10,465	30,000	10,000	10,000	10,000	10,000	20,000	10,000
(m ³)	p ₂	20,000	10,000	10,000	10,000	15,000	12,437	37,563	50,000	30,000
sulfur (ppm)		1407	1553	2186	1547	430	1703	805	1151	1040

Table S110. Microcut yields in the feedstocks for CDU₃ at the best solution to Example 11

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₃ (%)									Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
HK-90	7.13	5.67	3.41	3.35	2.34	2.30	2.18	1.99	3.13	3.55
90-110	3.72	2.97	2.29	1.98	1.57	1.86	1.11	1.63	2.09	2.36
110-130	2.95	2.28	2.62	2.26	2.50	2.31	1.26	2.05	2.49	2.29
130-140	1.29	1.00	1.52	1.37	1.51	1.34	1.15	1.13	1.38	1.30
140-150	0.90	0.71	1.16	1.01	1.16	1.17	1.25	0.96	1.12	1.25
150-170	2.63	2.10	2.74	2.59	2.56	2.45	2.65	2.28	2.57	2.53
170-190	2.17	1.80	2.82	2.68	2.45	2.46	2.23	2.31	2.62	2.39
190-210	2.08	1.77	2.23	2.12	2.20	2.38	2.11	2.35	2.35	2.28
210-230	2.46	2.12	3.28	3.31	2.34	2.91	2.72	2.59	2.89	2.72
230-250	3.61	3.06	3.29	3.28	3.28	3.60	3.76	3.15	3.23	3.39
250-275	4.16	3.69	4.79	4.79	4.74	4.51	4.55	4.18	4.47	4.26
275-300	4.66	4.25	4.57	4.47	4.66	3.85	4.42	4.90	4.80	4.30
300-325	5.16	4.83	4.82	5.04	4.34	5.26	5.18	4.35	4.47	4.77
325-350	4.72	4.66	4.68	4.67	4.54	5.00	4.37	4.23	4.45	4.84
350-400	5.36	5.02	5.31	4.73	6.85	6.11	4.58	5.01	5.44	5.88
400-450	10.55	10.34	13.49	14.24	13.99	13.85	15.66	10.91	11.79	11.77
450-500	8.52	9.34	9.48	10.34	9.43	10.61	11.57	9.62	9.15	9.38
>500	26.63	32.98	26.22	26.93	28.59	27.84	28.77	36.37	31.24	29.90

Table S111. TBP data of the feedstocks for CDU₃ at the best solution to Example 11

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₃ (%)									<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	f ₉	
90	7.13	5.67	3.41	3.35	2.34	2.30	2.18	1.99	3.13	3.55
110	10.86	8.64	5.70	5.33	3.91	4.16	3.29	3.61	5.22	5.91
130	13.81	10.93	8.32	7.59	6.41	6.47	4.55	5.66	7.71	8.20
140	15.10	11.93	9.84	8.97	7.92	7.80	5.70	6.79	9.09	9.50
150	16.00	12.64	11.00	9.98	9.08	8.97	6.95	7.75	10.22	10.75
170	18.64	14.74	13.74	12.57	11.64	11.42	9.61	10.03	12.79	13.28
190	20.80	16.54	16.56	15.25	14.08	13.89	11.83	12.34	15.41	15.67
210	22.88	18.31	18.79	17.37	16.29	16.27	13.95	14.69	17.76	17.95
230	25.35	20.43	22.07	20.68	18.63	19.17	16.67	17.28	20.65	20.67
250	28.95	23.49	25.36	23.97	21.91	22.78	20.43	20.43	23.88	24.06
275	33.11	27.18	30.15	28.76	26.65	27.29	24.98	24.61	28.35	28.32
300	37.77	31.44	34.73	33.23	31.31	31.14	29.40	29.51	33.15	32.62
325	42.93	36.27	39.55	38.27	35.65	36.41	34.58	33.87	37.62	37.39
350	47.65	40.92	44.23	42.95	40.19	41.40	38.95	38.10	42.07	42.23
400	53.01	45.94	49.54	47.68	47.04	47.51	43.53	43.10	47.51	48.11
450	63.57	56.29	63.03	61.92	61.03	61.36	59.19	54.02	59.30	59.88
500	72.09	65.53	72.51	72.26	70.46	71.97	70.76	63.64	68.45	69.26

Example 11 - Sequential Approach
TBP curves of the feedstocks for CDU-3
15 charging tanks, 9 feedstocks

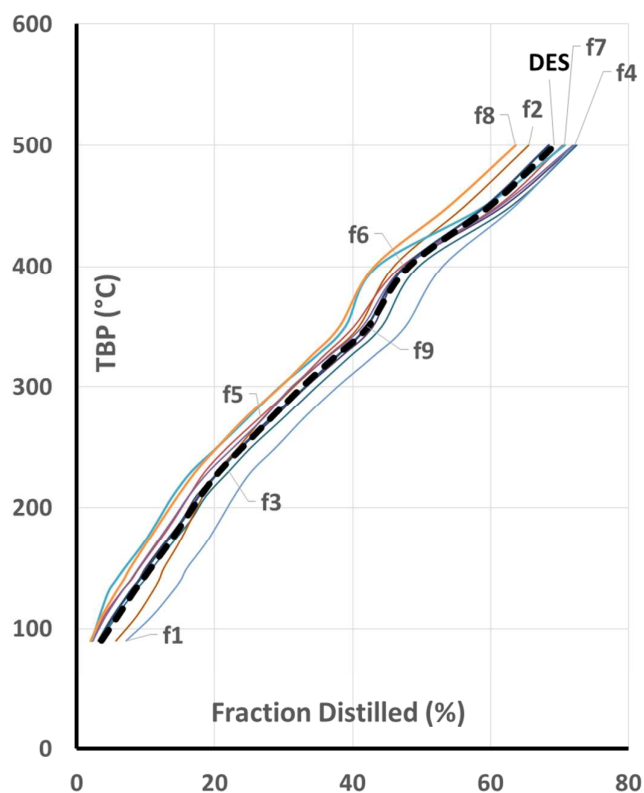


Figure S36. TBP curves of the feedstocks for CDU₃ at the best solution to Example 11

Table S112. MCOBS schedule for CDU₄ at the best solution to Example 11 using 8 time slots

		Best feedstock sequence for CDU ₄							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.33	5.98	7.08	9.58	12.08	15.42	20.00
end time (day)		3.33	5.98	7.08	9.58	12.08	15.42	20.00	24.58
added tank in	p ₁	tk ₁₅	tk ₂₂	tk ₂₀	tk ₁₁	tk ₆	tk ₅	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₁	tk ₄	tk ₂₉	-	tk ₂₄	tk ₂₇	tk ₁₇
tank sequence in	p ₁	tk ₁₇	tk ₁₅	tk ₁₅	tk ₅₅	tk ₂	tk ₂₁	tk ₉	tk ₃₃
	p ₂	tk ₃₉	tk ₂₆	tk ₅₁	tk ₅₇	tk ₁₃	tk ₂₄	tk ₅₀	tk ₅₀
emptied tank in	p ₁	tk ₁₅	tk ₂₂	tk ₂₀	tk ₁₁	tk ₆	tk ₅	tk ₂₃	tk ₁₃
	p ₂	tk ₇	tk ₁	tk ₄	-	tk ₂₉	tk ₂₄	tk ₂₇	tk ₁₇
crude oil in	p ₁	cr ₈	cr ₇	cr ₇	cr ₁₃	cr ₁	cr ₄	cr ₄	cr ₂
	p ₂	cr ₆	cr ₃	cr ₁₂	cr ₁₃	cr ₅	cr ₉	cr ₁₁	cr ₁₁
flow rate in	p ₁	250.0	185.4	121.6	166.7	333.3	250.0	272.8	272.6
(m ³ /h)	p ₂	250.0	314.6	378.4	333.3	166.7	250.0	227.2	227.4
batch size	p ₁	20,000	11,787	3,213	10,000	20,000	20,000	30,000	30,000
(m ³)	p ₂	20,000	20,000	10,000	20,000	10,000	20,000	24,975	25,025
sulfur (ppm)		1444	903	930	1800	1607	1693	2500	1783

Table S113. Microcut yields in the feedstocks for CDU₄ at the best solution to Example 11

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₄ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	3.92	4.39	3.81	3.30	2.52	2.57	2.60	4.42	3.55
90-110	2.26	2.19	2.32	2.26	1.99	2.44	2.23	2.53	2.36
110-130	1.04	2.30	2.63	2.83	2.46	2.74	2.36	2.32	2.29
130-140	1.03	1.29	1.38	1.61	1.56	1.37	1.23	1.27	1.30
140-150	1.95	0.84	1.06	1.26	1.20	1.36	1.19	1.00	1.25
150-170	2.81	2.64	2.65	2.78	2.52	2.53	2.19	2.39	2.53
170-190	2.04	2.29	2.40	2.79	2.51	2.58	2.29	2.64	2.39
190-210	2.07	2.13	2.39	2.30	2.36	2.74	2.29	1.98	2.28
210-230	2.33	2.75	2.50	2.45	2.61	2.83	2.66	3.38	2.72
230-250	3.47	3.82	3.58	3.29	3.24	3.57	3.23	2.84	3.39
250-275	3.00	4.90	4.54	4.78	5.68	4.08	3.87	4.22	4.26
275-300	3.99	4.73	5.00	4.67	5.20	4.17	3.45	4.20	4.30
300-325	4.36	5.47	4.67	4.51	4.31	4.77	4.93	4.79	4.77
325-350	4.13	4.64	4.43	4.64	5.87	4.81	5.09	4.72	4.84
350-400	4.32	5.12	5.89	6.21	8.67	6.43	6.32	4.26	5.88
400-450	10.12	14.78	11.89	13.16	13.34	10.14	11.47	11.86	11.77
450-500	9.14	10.68	9.09	8.89	8.84	8.95	9.82	9.54	9.38
>500	36.47	24.48	29.47	26.53	24.25	32.24	32.20	30.59	29.90

Table S114. TBP data of the feedstocks for CDU₄ at the best solution to Example 11

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₄ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	3.92	4.39	3.81	3.30	2.52	2.57	2.60	4.42	3.55
110	6.19	6.59	6.13	5.56	4.51	5.01	4.83	6.96	5.91
130	7.23	8.89	8.76	8.39	6.97	7.75	7.19	9.28	8.20
140	8.26	10.18	10.14	10.00	8.52	9.12	8.43	10.55	9.50
150	10.22	11.02	11.20	11.26	9.72	10.48	9.62	11.54	10.75
170	13.03	13.66	13.85	14.04	12.25	13.02	11.81	13.94	13.28
190	15.08	15.95	16.25	16.83	14.76	15.60	14.11	16.58	15.67
210	17.15	18.08	18.64	19.13	17.11	18.34	16.40	18.56	17.95
230	19.48	20.83	21.14	21.58	19.72	21.17	19.06	21.93	20.67
250	22.95	24.65	24.73	24.87	22.96	24.75	22.29	24.78	24.06
275	25.96	29.55	29.27	29.65	28.65	28.83	26.16	29.00	28.32
300	29.95	34.28	34.27	34.32	33.84	33.00	29.62	33.19	32.62
325	34.31	39.75	38.94	38.83	38.16	37.77	34.55	37.98	37.39
350	38.44	44.39	43.37	43.47	44.02	42.58	39.64	42.70	42.23
400	42.77	49.51	49.26	49.68	52.70	49.01	45.96	46.96	48.11
450	52.89	65.29	61.15	62.84	66.03	59.15	57.43	58.82	59.88
500	62.3	74.97	70.24	71.73	74.87	68.11	67.25	68.36	69.26

Example 11 - Sequential Approach
TBP curves of the feedstocks for CDU-4
14 charging tanks, 8 feedstocks

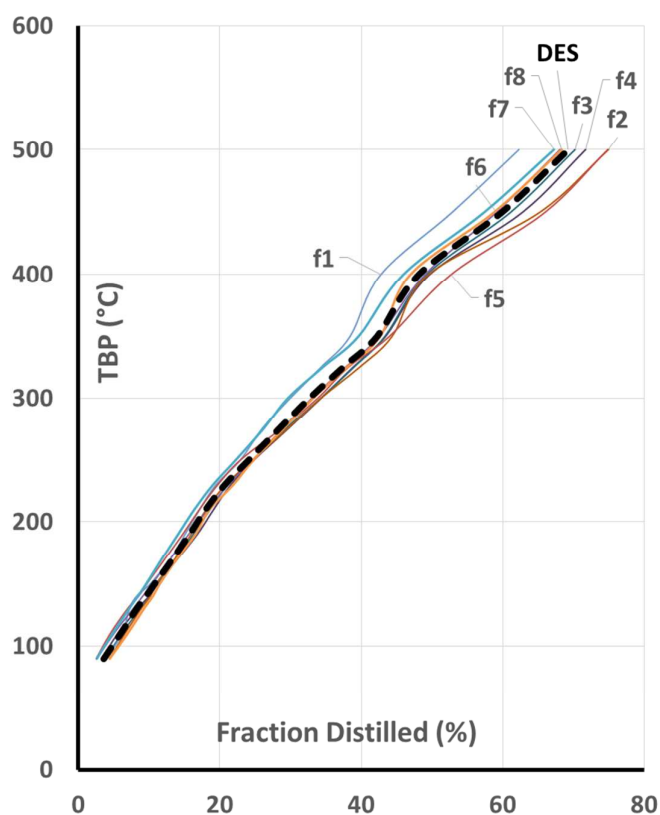


Figure S37. TBP curves of the feedstocks for CDU₄ at the best solution to Example 11

II.11 Detailed results for Example 12 using the sequential approach

Table S115. MCOBS schedule for CDU₁ at the best solution to Example 12 using 8 time slots

		Best feedstock sequence for CDU ₁							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	2.50	6.67	11.67	15.00	18.33	20.83	22.30
end time (day)		2.50	6.67	11.67	15.00	18.33	20.83	22.30	25.00
added tank in	p ₁	tk ₅₈	tk ₃₃	tk ₆₀	tk ₂₁	tk ₃₆	tk ₂₂	tk ₁₀	tk ₂₃
	p ₂	tk ₂₈	tk ₃₀	tk ₃₉	tk ₃₈	tk ₄₉	tk ₅₃	tk ₄₄	-
tank sequence in	p ₁	tk ₅₈	tk ₃₃	tk ₆₀	tk ₂₁	tk ₃₆	tk ₂₂	tk ₁₀	tk ₂₃
	p ₂	tk ₂₈	tk ₃₀	tk ₃₉	tk ₃₈	tk ₄₉	tk ₅₃	tk ₄₄	tk ₄₄
emptied tank in	p ₁	tk ₅₈	tk ₃₃	tk ₆₀	tk ₂₁	tk ₃₆	tk ₂₂	tk ₁₀	tk ₂₃
	p ₂	tk ₂₈	tk ₃₀	tk ₃₉	tk ₃₈	tk ₄₉	tk ₅₃	-	tk ₄₄
crude oil in	p ₁	cr ₁₄	cr ₂	cr ₁₄	cr ₄	cr ₄	cr ₄	cr ₄	cr ₄
	p ₂	cr ₆	cr ₆	cr ₆	cr ₆	cr ₁₁	cr ₁₂	cr ₃	cr ₃
flow rate in	p ₁	333.3	300.0	333.3	250.0	250.0	166.7	284.9	308.2
(m ³ /h)	p ₂	166.7	200.0	166.7	250.0	250.0	333.3	215.1	191.8
batch size	p ₁	20,000	30,000	40,000	20,000	20,000	10,000	10,000	20,000
(m ³)	p ₂	10,000	20,000	20,000	20,000	20,000	20,000	7,550	12,450
sulfur (ppm)		2213	1727	2213	2437	2467	1531	1956	2051

Table S116. Microcut yields in the feedstocks for CDU₁ at the best solution to Example 12

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₁ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.15	4.76	4.15	2.43	2.45	2.49	2.70	2.84	2.35
90-110	2.58	2.78	2.58	2.10	2.07	2.15	2.29	2.45	1.83
110-130	2.33	2.30	2.33	1.96	2.21	2.66	2.66	2.79	2.50
130-140	1.23	1.17	1.23	0.94	1.17	1.42	1.46	1.50	1.01
140-150	1.00	0.96	1.00	0.99	1.12	1.29	1.33	1.40	1.36
150-170	2.26	2.20	2.26	1.70	2.10	2.55	2.59	2.65	2.72
170-190	2.51	2.52	2.51	1.87	2.20	2.54	2.63	2.69	2.53
190-210	1.90	1.85	1.90	1.94	2.20	2.56	2.55	2.61	3.19
210-230	3.09	3.24	3.09	2.20	2.58	2.67	3.03	3.08	3.13
230-250	2.63	2.50	2.63	2.64	3.15	3.48	3.71	3.74	4.06
250-275	3.94	3.78	3.94	3.18	3.83	4.30	4.45	4.43	4.93
275-300	4.10	3.99	4.10	3.13	3.46	4.34	3.74	3.69	4.98
300-325	4.48	4.51	4.48	4.51	4.89	4.63	5.28	5.28	5.15
325-350	4.71	4.74	4.71	5.02	5.04	4.72	5.13	5.18	5.22
350-400	4.58	4.13	4.58	5.98	6.14	6.57	6.55	6.72	4.76
400-450	10.86	10.24	10.86	9.78	11.62	11.42	12.97	12.64	15.75
450-500	9.09	9.02	9.09	9.71	10.02	9.11	9.97	9.74	9.87
>500	33.03	33.92	33.03	38.79	33.09	31.03	26.84	26.46	23.77

Table S117. TBP data of the feedstocks for CDU₁ at the best solution to Example 12

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₁ (%)								$cydref_{mc}$
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.15	4.76	4.15	2.43	2.45	2.49	2.70	2.84	2.35
110	6.72	7.54	6.72	4.53	4.53	4.65	4.98	5.29	4.18
130	9.05	9.84	9.05	6.49	6.74	7.30	7.64	8.08	6.68
140	10.28	11.01	10.28	7.44	7.91	8.72	9.10	9.58	7.69
150	11.28	11.97	11.28	8.43	9.03	10.02	10.43	10.98	9.05
170	13.54	14.17	13.54	10.14	11.13	12.56	13.02	13.62	11.77
190	16.05	16.69	16.05	12.01	13.34	15.11	15.65	16.31	14.30
210	17.95	18.54	17.95	13.96	15.54	17.67	18.20	18.93	17.49
230	21.04	21.78	21.04	16.16	18.12	20.33	21.23	22.00	20.62
250	23.67	24.28	23.67	18.81	21.27	23.81	24.94	25.75	24.68
275	27.61	28.06	27.61	21.99	25.10	28.11	29.39	30.18	29.61
300	31.71	32.05	31.71	25.12	28.57	32.45	33.13	33.87	34.59
325	36.19	36.56	36.19	29.63	33.46	37.08	38.40	39.15	39.74
350	40.90	41.30	40.90	34.66	38.50	41.80	43.53	44.33	44.96
400	45.48	45.43	45.48	40.64	44.65	48.37	50.09	51.05	49.72
450	56.34	55.67	56.34	50.42	56.27	59.80	63.06	63.69	65.47
500	65.43	64.69	65.43	60.13	66.29	68.91	73.03	73.43	75.34

Example 12 - Sequential Approach
TBP curves of the feedstocks for CDU-1
15 charging tanks, 8 feedstocks

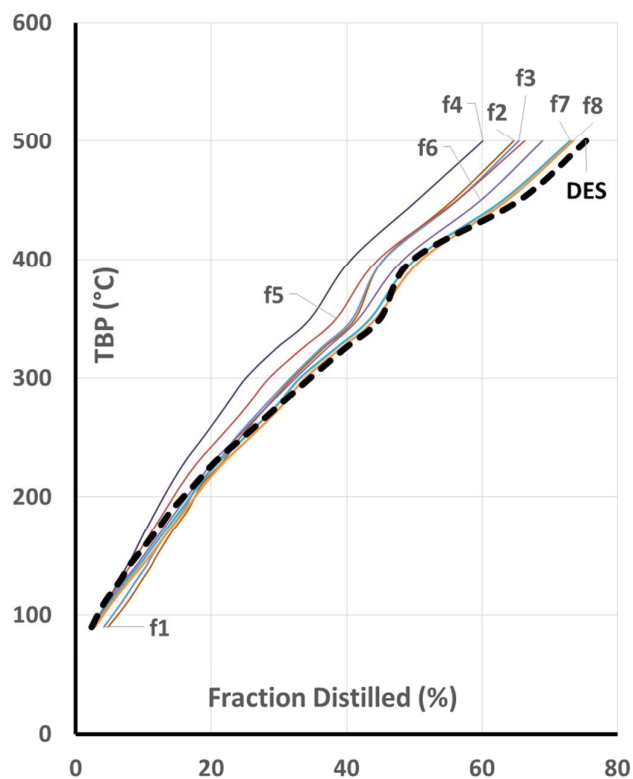


Figure S38. TBP curves of the feedstocks for CDU₁ at the best solution to Example 12

Table S118. MCOBS schedule for CDU₂ at the best solution to Example 12 using 8 time slots

		Best feedstock sequence for CDU ₂							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	3.33	9.17	13.81	15.83	17.50	19.17	22.50
end time (day)		3.33	9.17	13.81	15.83	17.50	19.17	22.50	24.58
added tank in	p ₁	tk ₄₇	tk ₄₀	tk ₄₂	tk ₄₁	tk ₂₀	tk ₁₃	tk ₄₆	tk ₅₉
	p ₂	tk ₅₅	tk ₂₅	tk ₂₉	-	tk ₄₃	tk ₅₁	tk ₂₄	tk ₅₂
tank sequence in	p ₁	tk ₄₇	tk ₄₀	tk ₄₂	tk ₄₁	tk ₂₀	tk ₁₃	tk ₄₆	tk ₅₉
	p ₂	tk ₅₅	tk ₂₅	tk ₂₉	tk ₂₉	tk ₄₃	tk ₅₁	tk ₂₄	tk ₅₂
emptied tank in	p ₁	tk ₄₇	tk ₄₀	tk ₄₂	tk ₄₁	tk ₂₀	tk ₁₃	tk ₄₆	tk ₅₉
	p ₂	tk ₅₅	tk ₂₅	-	tk ₂₉	tk ₄₃	tk ₅₁	tk ₂₄	tk ₅₂
crude oil in	p ₁	cr ₁₀	cr ₇	cr ₈	cr ₈	cr ₄	cr ₅	cr ₁₀	cr ₁₄
	p ₂	cr ₁₃	cr ₉	cr ₆	cr ₆	cr ₉	cr ₁₂	cr ₉	cr ₁₂
flow rate in	p ₁	375.0	142.9	179.3	206.3	250.0	250.0	250.0	200.0
(m ³ /h)	p ₂	125.0	357.1	320.7	293.7	250.0	250.0	250.0	300.0
batch size	p ₁	30,000	20,000	20,000	10,000	10,000	10,000	20,000	10,000
(m ³)	p ₂	10,000	50,000	35,763	14,237	10,000	10,000	20,000	15,000
sulfur (ppm)		2438	705	1612	1548	1693	2429	1601	1448

Table S119. Microcut yields in the feedstocks for CDU₂ at the best solution to Example 12

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₂ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	4.01	3.73	3.04	3.38	2.57	2.29	2.66	3.35	2.35
90-110	2.78	2.33	1.75	1.94	2.44	2.08	2.02	2.26	1.83
110-130	3.07	2.41	0.76	0.87	2.74	2.21	2.38	2.62	2.50
130-140	1.69	1.19	0.75	0.85	1.37	1.42	1.30	1.45	1.01
140-150	1.33	0.95	1.42	1.62	1.36	1.13	1.08	1.17	1.36
150-170	2.94	2.51	2.11	2.38	2.53	2.36	2.49	2.66	2.72
170-190	3.04	2.27	1.62	1.78	2.58	2.42	2.55	2.72	2.53
190-210	2.37	2.46	1.70	1.84	2.74	2.47	2.36	2.35	3.19
210-230	3.27	2.49	1.94	2.09	2.83	2.71	2.87	3.03	3.13
230-250	3.30	3.58	2.84	3.08	3.57	3.17	3.20	3.25	4.06
250-275	4.80	4.29	2.75	2.85	4.08	5.95	4.37	4.54	4.93
275-300	4.68	5.15	3.68	3.80	4.17	5.55	4.83	4.77	4.98
300-325	4.64	4.70	4.18	4.25	4.77	4.27	4.45	4.52	5.15
325-350	4.71	4.26	4.22	4.19	4.81	6.40	4.38	4.51	5.22
350-400	5.73	5.16	4.20	4.25	6.43	9.07	5.17	5.46	4.76
400-450	12.53	10.54	9.98	10.03	10.14	12.10	11.33	11.89	15.75
450-500	8.48	9.22	9.85	9.58	8.95	8.71	9.24	8.99	9.87
>500	24.99	33.00	41.49	39.57	32.24	25.21	32.80	29.89	23.77

Table S120. TBP data of the feedstocks for CDU₂ at the best solution to Example 12

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₂ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	4.01	3.73	3.04	3.38	2.57	2.29	2.66	3.35	2.35
110	6.79	6.05	4.79	5.32	5.01	4.38	4.69	5.62	4.18
130	9.86	8.46	5.55	6.19	7.75	6.59	7.07	8.24	6.68
140	11.55	9.65	6.30	7.05	9.12	8.01	8.37	9.69	7.69
150	12.89	10.60	7.72	8.67	10.48	9.14	9.45	10.86	9.05
170	15.83	13.11	9.83	11.05	13.02	11.51	11.95	13.52	11.77
190	18.88	14.37	11.46	12.84	15.60	13.93	14.50	16.24	14.30
210	21.24	17.83	13.16	14.68	18.34	16.40	16.87	18.60	17.49
230	24.52	20.32	15.10	16.77	21.17	19.11	19.74	21.62	20.62
250	27.82	23.91	17.93	19.85	24.75	22.29	22.94	24.87	24.68
275	32.63	28.20	20.69	22.70	28.83	28.24	27.31	29.41	29.61
300	37.30	33.34	24.38	26.50	33.00	33.79	32.15	34.18	34.59
325	41.95	38.04	28.55	30.75	37.77	38.06	36.60	38.70	39.74
350	46.66	42.31	32.78	34.94	42.58	44.46	40.98	43.20	44.96
400	52.39	47.47	36.98	39.19	49.01	53.53	46.16	48.67	49.72
450	64.92	58.01	46.96	49.22	59.15	65.63	57.49	60.56	65.47
500	73.40	67.23	56.81	58.80	68.11	74.35	66.73	69.55	75.34

Example 12 - Sequential Approach
TBP curves of the feedstocks for CDU-2
15 charging tanks, 8 feedstocks

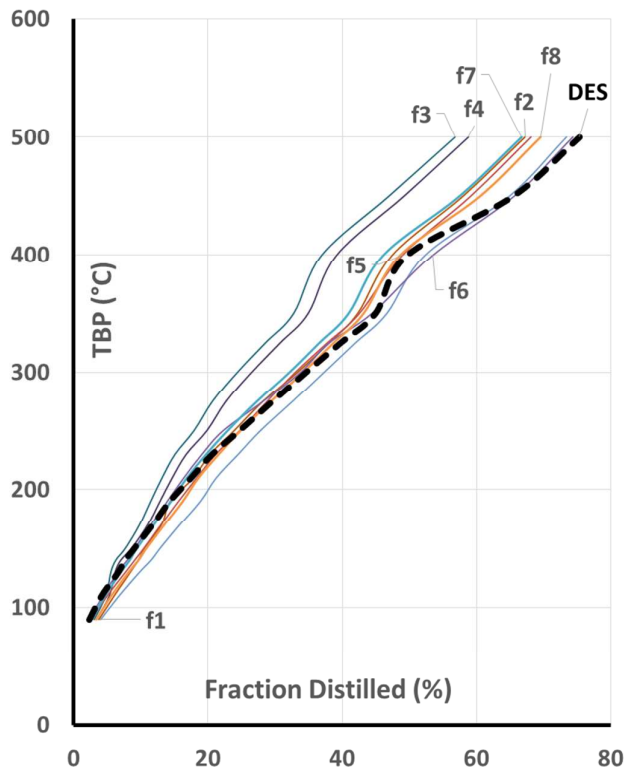


Figure S39. TBP curves of the feedstocks for CDU₂ at the best solution to Example 12

Table S121. MCOBS schedule for CDU₃ at the best solution to Example 12 using 8 time slots

		Best feedstock sequence for CDU ₃							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	5.83	6.87	10.00	12.50	16.67	20.42	25.42
end time (day)		5.83	6.87	10.00	12.50	16.67	20.42	25.42	28.33
added tank in	p ₁	tk ₁₇	tk ₁₂	-	tk ₃₇	tk ₉	tk ₁₁	tk ₅₆	tk ₅₇
	p ₂	tk ₇	tk ₃₁	tk ₂	tk ₃₂	tk ₃₅	tk ₄₅	tk ₅₄	tk ₄
tank sequence in	p ₁	tk ₁₇	tk ₁₂	tk ₁₂	tk ₃₇	tk ₉	tk ₁₁	tk ₅₆	tk ₅₇
	p ₂	tk ₇	tk ₃₁	tk ₂	tk ₃₂	tk ₃₅	tk ₄₅	tk ₅₄	tk ₄
emptied tank in	p ₁	tk ₁₇	-	tk ₁₂	tk ₃₇	tk ₉	tk ₁₁	tk ₅₆	tk ₅₇
	p ₂	tk ₇	tk ₃₁	tk ₂	tk ₃₂	tk ₃₅	tk ₄₅	tk ₅₄	tk ₄
crude oil in	p ₁	cr ₈	cr ₅	cr ₅	cr ₅	cr ₄	cr ₄	cr ₁₃	cr ₁₃
	p ₂	cr ₃	cr ₁	cr ₁	cr ₁	cr ₃	cr ₃	cr ₁₂	cr ₁
flow rate in	p ₁	142.9	100.0	233.3	166.7	300.0	277.8	250.0	285.7
(m ³ /h)	p ₂	357.1	400.0	266.7	333.3	200.0	222.2	250.0	214.3
batch size	p ₁	20,000	2,500	17,500	10,000	30,000	25,000	30,000	20,000
(m ³)	p ₂	50,000	10,000	20,000	20,000	20,000	20,000	30,000	15,000
sulfur (ppm)		809	1136	2077	1607	2017	1927	1340	1213

Table S122. Microcut yields in the feedstocks for CDU₃ at the best solution to Example 12

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₃ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	2.65	2.45	2.59	2.52	2.79	2.65	2.50	2.89	2.35
90-110	1.39	1.82	2.16	1.99	2.39	2.24	1.80	1.96	1.83
110-130	1.33	2.47	2.44	2.46	2.74	2.62	2.44	2.69	2.50
130-140	1.24	1.54	1.57	1.56	1.48	1.44	1.40	1.57	1.01
140-150	1.50	1.18	1.22	1.20	1.38	1.32	1.12	1.22	1.36
150-170	2.91	2.54	2.51	2.52	2.63	2.58	2.53	2.69	2.72
170-190	2.35	2.49	2.53	2.51	2.67	2.61	2.50	2.64	2.53
190-210	2.24	2.29	2.42	2.36	2.59	2.53	2.28	2.26	3.19
210-230	2.82	2.50	2.72	2.61	3.06	3.02	2.36	2.40	3.13
230-250	3.95	3.26	3.22	3.24	3.73	3.70	3.24	3.29	4.06
250-275	4.49	5.31	6.06	5.68	4.44	4.46	4.44	4.76	4.93
275-300	4.48	4.98	5.41	5.20	3.71	3.75	4.75	4.67	4.98
300-325	5.16	4.32	4.30	4.31	5.28	5.28	4.39	4.44	5.15
325-350	4.31	5.34	6.40	5.87	5.16	5.11	4.46	4.60	5.22
350-400	4.60	7.94	9.40	8.67	6.66	6.50	6.01	6.48	4.76
400-450	15.17	13.60	13.07	13.34	12.76	13.07	12.66	13.52	15.75
450-500	11.10	9.07	8.56	8.84	9.82	10.05	9.33	9.12	9.87
>500	27.81	25.99	22.51	24.25	26.59	26.95	30.69	27.41	23.77

Table S123. TBP data of the feedstocks for CDU₃ at the best solution to Example 12

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₃ (%)								<i>cydref_{mc}</i>
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	2.65	2.45	2.59	2.52	2.79	2.65	2.50	2.89	2.35
110	4.04	4.27	4.75	4.51	5.18	4.89	4.30	4.85	4.18
130	5.38	6.74	7.19	6.97	7.93	7.51	6.74	7.54	6.68
140	6.61	8.28	8.76	8.52	9.41	8.95	8.15	9.11	7.69
150	8.11	9.47	9.98	9.72	10.79	10.26	9.27	10.33	9.05
170	11.02	12.00	12.49	12.25	13.14	12.84	11.80	13.01	11.77
190	13.37	14.49	15.02	14.76	16.08	15.45	14.30	15.66	14.30
210	15.60	16.78	17.44	17.11	18.67	17.98	16.59	17.91	17.49
230	18.42	19.29	20.16	19.72	21.73	21.00	18.95	20.32	20.62
250	22.37	22.54	23.38	22.96	25.46	24.69	22.19	23.60	24.68
275	26.86	27.85	29.44	28.65	29.90	29.15	26.74	28.36	29.61
300	31.34	32.83	34.86	33.84	33.61	32.90	31.49	33.03	34.59
325	36.50	37.15	39.16	38.16	38.89	38.17	35.89	37.47	39.74
350	40.82	42.49	45.56	44.02	44.5	43.29	40.35	42.06	44.96
400	45.42	50.43	54.96	52.70	50.71	49.79	46.37	48.55	49.72
450	60.59	64.03	68.03	66.03	63.47	62.86	59.03	62.06	65.47
500	71.69	73.11	76.63	74.87	73.29	72.91	68.37	71.19	75.34

Example 12 - Sequential Approach
TBP curves of the feedstocks for CDU-3
15 charging tanks, 8 feedstocks

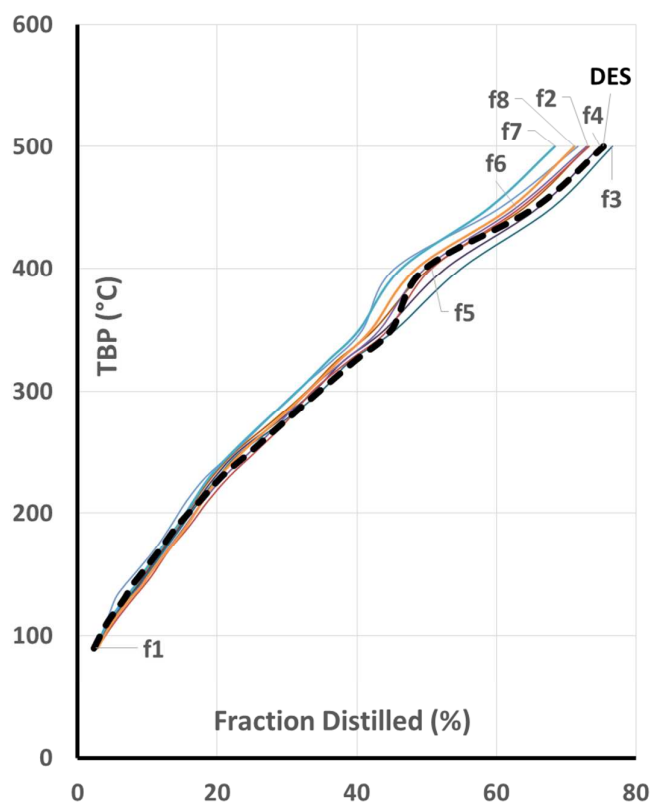


Figure S40. TBP curves of the feedstocks for CDU₃ at the best solution for Example 12

Table S124. MCOBS schedule for CDU₄ at the best solution to Example 12 using 8 time slots

		Best feedstock sequence for CDU ₄							
		f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈
start time (day)		0	6.67	9.58	11.25	12.92	15.62	18.75	25.42
end time (day)		6.67	9.58	11.25	12.92	15.62	18.75	25.42	28.75
added tank in	p ₁	tk ₁₆	tk ₁₅	tk ₃₄	tk ₁₉	tk ₁₈	-	tk ₆	tk ₅
	p ₂	tk ₁₄	tk ₁	tk ₂₇	tk ₄₈	tk ₈	tk ₃	tk ₅₀	tk ₂₆
tank sequence in	p ₁	tk ₁₆	tk ₁₅	tk ₃₄	tk ₁₉	tk ₁₈	tk ₁₈	tk ₆	tk ₅
	p ₂	tk ₁₄	tk ₁	tk ₂₇	tk ₄₈	tk ₈	tk ₃	tk ₅₀	tk ₂₆
emptied tank in	p ₁	tk ₁₆	tk ₁₅	tk ₃₄	tk ₁₉	-	tk ₁₈	tk ₆	tk ₅
	p ₂	tk ₁₄	tk ₁	tk ₂₇	tk ₄₈	tk ₈	tk ₃	tk ₅₀	tk ₂₆
crude oil in	p ₁	cr ₇	cr ₇	cr ₂	cr ₈	cr ₈	cr ₈	cr ₂	cr ₂
	p ₂	cr ₆	cr ₁	cr ₃	cr ₁₁	cr ₃	cr ₁	cr ₁₁	cr ₃
flow rate in	p ₁	312.5	214.3	250.0	250.0	192.3	100.0	187.5	250.0
(m ³ /h)	p ₂	187.5	285.7	250.0	250.0	307.7	400.0	312.5	250.0
batch size	p ₁	50,000	15,000	10,000	10,000	12,500	7,500	30,000	20,000
(m ³)	p ₂	30,000	20,000	10,000	10,000	20,000	30,000	50,000	20,000
sulfur (ppm)		1444	712	1156	1474	815	514	1882	1156

Table S125. Microcut yields in the feedstocks for CDU₄ at the best solution to Example 12

Boiling range (°C)	Yield of each microcut in the feedstocks for CDU ₄ (%)								Desired microcut yield (%)
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
HK-90	6.76	5.77	4.14	3.95	3.26	3.28	3.31	4.14	2.35
90-110	3.53	3.21	2.32	2.23	1.77	2.08	1.86	2.32	1.83
110-130	2.78	3.32	2.42	1.29	1.43	2.41	1.77	2.42	2.50
130-140	1.22	1.69	1.42	1.25	1.35	1.61	1.02	1.42	1.01
140-150	0.85	1.23	1.06	2.08	1.82	1.70	0.78	1.06	1.36
150-170	2.50	3.09	2.70	3.21	3.24	3.11	2.00	2.70	2.72
170-190	2.07	2.68	2.85	2.37	2.51	2.67	2.19	2.85	2.53
190-210	2.00	2.44	2.17	2.33	2.40	2.44	1.75	2.17	3.19
210-230	2.37	2.72	3.61	2.71	2.94	2.61	2.86	3.61	3.13
230-250	3.47	3.94	3.29	3.97	4.19	3.77	2.66	3.29	4.06
250-275	4.04	4.93	4.80	3.65	4.41	4.57	3.97	4.80	4.93
275-300	4.55	5.04	4.48	4.32	4.56	4.74	4.00	4.48	4.98
300-325	5.08	5.01	5.13	4.74	5.14	4.48	4.69	5.13	5.15
325-350	4.70	4.67	4.72	4.14	4.24	4.39	4.65	4.72	5.22
350-400	5.27	6.53	4.41	4.49	4.62	6.43	4.24	4.41	4.76
400-450	10.50	12.72	13.82	11.96	14.54	13.31	12.31	13.82	15.75
450-500	8.71	8.36	10.07	9.45	10.48	8.87	10.39	10.07	9.87
>500	28.26	21.77	25.91	30.77	26.55	26.62	34.41	25.91	23.77

Table S126. TBP data of the feedstocks for CDU₄ at the best solution to Example 12

TBP (°C)	Cumulative microcut yields in the feedstocks for CDU ₄ (%)								$cydref_{mc}$
	f ₁	f ₂	f ₃	f ₄	f ₅	f ₆	f ₇	f ₈	
90	6.76	5.77	4.14	3.95	3.26	3.28	3.31	4.14	2.35
110	10.29	8.98	6.47	6.18	5.03	5.36	5.16	6.47	4.18
130	13.07	12.30	8.89	7.48	6.46	7.77	6.93	8.89	6.68
140	14.29	13.99	10.32	8.73	7.80	9.38	7.96	10.32	7.69
150	15.14	15.22	11.38	10.81	9.63	11.08	8.74	11.38	9.05
170	17.64	18.31	14.08	14.03	12.86	14.18	10.74	14.08	11.77
190	19.71	20.99	16.93	16.40	15.38	16.85	12.94	16.93	14.30
210	21.71	23.42	19.10	18.73	17.78	19.29	14.69	19.10	17.49
230	24.09	26.14	22.72	21.44	20.72	21.90	17.55	22.72	20.62
250	27.56	30.08	26.01	25.42	24.91	25.67	20.21	26.01	24.68
275	31.59	35.01	30.82	29.07	29.31	30.24	24.17	30.82	29.61
300	36.15	40.05	35.30	33.40	33.88	34.98	28.18	35.30	34.59
325	41.23	45.06	40.43	38.14	39.02	39.46	32.86	40.43	39.74
350	45.93	49.73	45.15	42.29	43.26	43.85	37.52	45.15	44.96
400	51.20	56.26	49.57	46.78	47.89	50.28	41.76	49.57	49.72
450	61.70	68.98	63.39	58.74	62.43	63.60	54.07	63.39	65.47
500	70.41	77.34	73.47	68.19	72.91	72.47	64.47	73.47	75.34

Example 12 - Sequential Approach
TBP curves of the feedstocks for CDU-4
15 charging tanks, 8 feedstocks

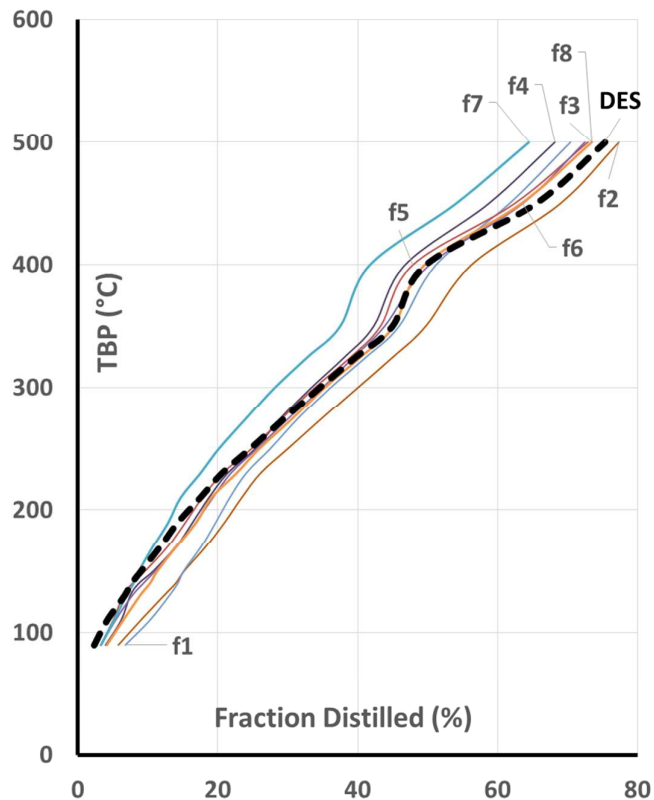


Figure S41. TBP curves of the feedstocks for CDU₄ at the best solution for Example 12