

Supplementary Material

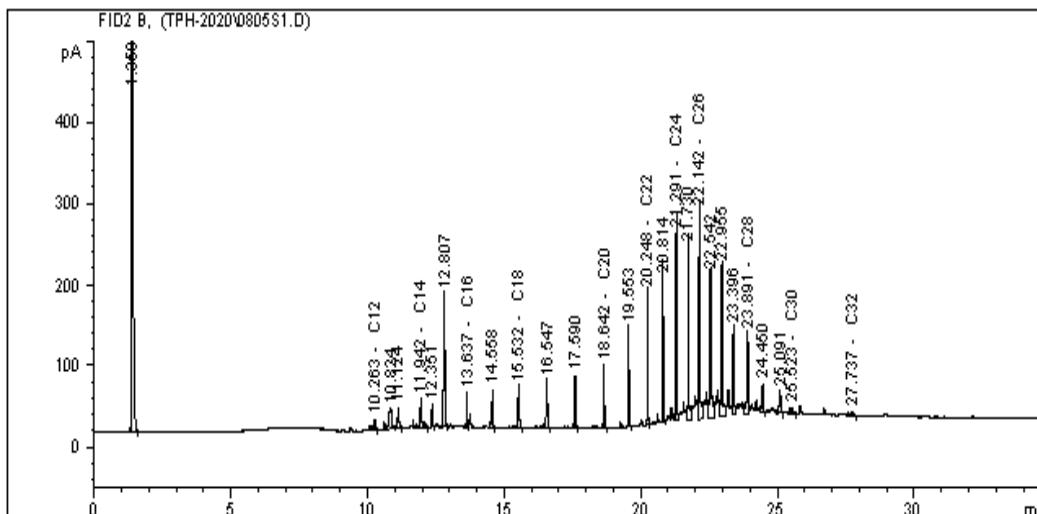


Fig. S1. Chromatogram of first stage of biosurfactant extraction waste type A.

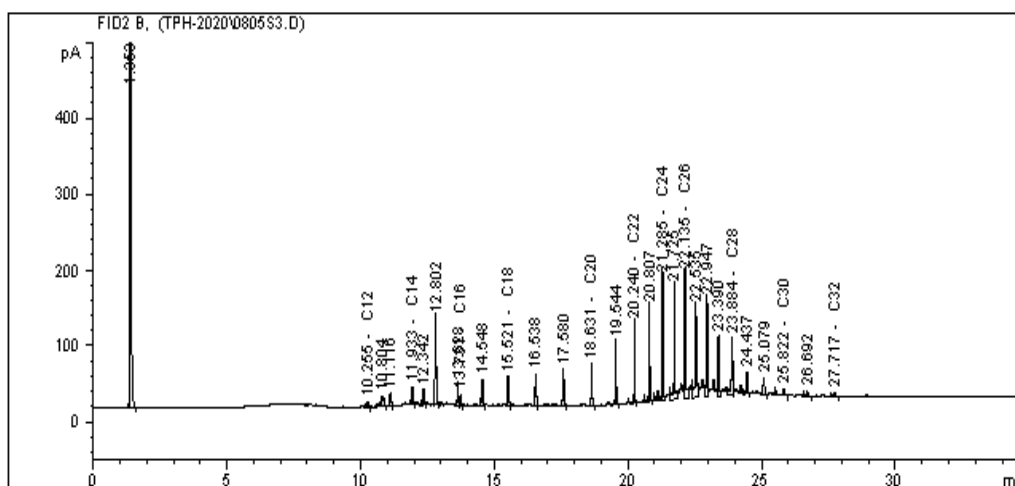


Fig. S2. Chromatogram of second stage of biosurfactant extraction waste type A.

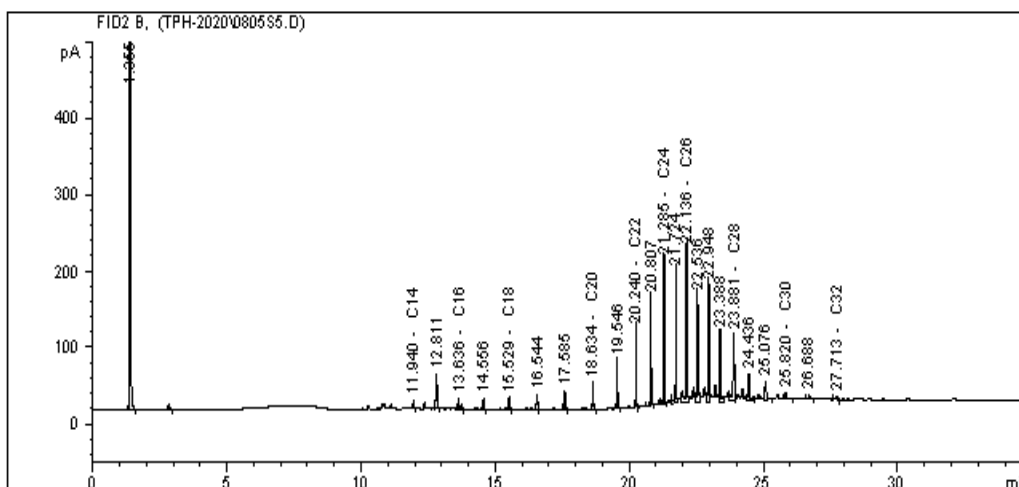


Fig. S3. Chromatogram of third stage of biosurfactant extraction waste type A.

Table S1. Biosurfactant extraction of oily contaminated soil.

Type of sample	pH	Moisture (%)	Density (kg/m ³)	TPH raw (%)	Solid: Biosurfactant	Extraction stage	TPH removal (%)
A Jawa	8.7	13.3	1.1	9	1.00	1	28.55
A Jawa	8.7	13.3	1.1	9	1.00	2	38.59
A Jawa	8.7	13.3	1.1	9	1.00	3	35.24
A Jawa	8.7	13.3	1.1	9	1.00	4	20.63
B Sumatera	17.86	11.6	1.2	17.86	1.00	1	15.18
B Sumatera	17.86	11.6	1.2	17.86	1.00	2	14.83
B Sumatera	17.86	11.6	1.2	17.86	1.00	3	17.92
B Sumatera	17.86	11.6	1.2	17.86	1.00	4	14.62

Table S2. Experiments on impact of combination biosurfactant in solvent extraction process.

Sample	Biosurfactant: Soil	Solid: Solvent	Initial TPH (%)	Type of solvent	Temperature (°C)	TPH removal (%)
1	1	0.5	17.86	Toluena	25	80.52
2	1	0.25	17.86	Toluena	25	85.33
3	1	0.2	17.86	Toluena	25	89.53
4	1	0.17	17.86	Toluena	25	76.82
5	1	0.5	17.86	Toluena	50	87.63
6	1	0.25	17.86	Toluena	50	89.42
7	1	0.2	17.86	Toluena	50	92.27
8	1	0.17	17.86	Toluena	50	85.33
9	1	0.5	17.86	Aseton	25	10.69
10	1	0.25	17.86	Aseton	25	13.49
11	1	0.2	17.86	Aseton	25	31.91
12	1	0.17	17.86	Aseton	25	49.27
13	1	0.5	17.86	Aseton	50	25.87
14	1	0.25	17.86	Aseton	50	40.09
15	1	0.2	17.86	Aseton	50	42.95
16	1	0.17	17.86	Aseton	50	58.40
17	0	0.5	17.86	Toluene	25	83.20
18	0	0.25	17.86	Toluene	25	86.34
19	0	0.2	17.86	Toluene	25	90.82
20	0	0.17	17.86	Toluene	25	87.35
21	0	0.5	17.86	Toluene	50	87.85
22	0	0.25	17.86	Toluene	50	93.95
23	0	0.2	17.86	Toluene	50	95.24
24	0	0.17	17.86	Toluene	50	94.34
25	0	0.5	17.86	Aseton	25	71.39
26	0	0.25	17.86	Aseton	25	84.66
27	0	0.2	17.86	Aseton	25	88.07
28	0	0.17	17.86	Aseton	25	90.26
29	0	0.5	17.86	Aseton	50	87.12
30	0	0.25	17.86	Aseton	50	85.44
31	0	0.2	17.86	Aseton	50	85.83
32	0	0.17	17.86	Aseton	50	87.29

Table S3. Contribution factor of combination of biosurfactant in solvent extraction process.

Variable	Contribution factor (%)
Biosurfactant: Soil	14.35
Soil: Solvent	11.50
Type of solvent	52.41
Temperature	21.73

Table S4. Normal distribution test result.

No	Model	Asymp. Sig. (2-tailed)	R ² adjusted	Sig. (F) ANOVA test
1	Regression model A (Biosurfactant multistage)	0.200	0.615	0.000
2	Regression model B (Combination of biosurfactant)	0.440	0.653	0.000

Table S5. Homoscedastic test.

Model	Variable	Sig.
Regression model A (Biosurfactant multistage)	TPH raw (%)	0.011
	Extraction stage	0.489
Regression model B (Combination of biosurfactant)	Biosurfactant: Soil	0.522
	Soil: Solvent	0.756
	Temperature (°C)	0.443

Table S6. Multicollinearity test.

Model	Variable	VIF
Regression model A (Biosurfactant multistage)	TPH raw (%)	1.000
	Extraction stage	1.000
Regression model B (Combination of biosurfactant)	Biosurfactant: Soil	1.000
	Soil: Solvent	1.000
	Type of solvent	1.000
	Temperature (°C)	1.000

Table S7. R² test.

No	Model	R ² adjusted
1	Regression model A (Biosurfactant multistage)	0.615
2	Regression model B (Combination of biosurfactant)	0.653

Table S8. F ANOVA test.

No	Model	Sig. (F)
1	Regression model A (Biosurfactant multistage)	0.000
2	Regression model B (Combination of biosurfactant)	0.000

Table S9. T test result.

Model	Variable	Sig.
Regression model A (Biosurfactant multistage)	TPH raw (%)	0.016
	Extraction stage	0.528
Regression model B (Combination of biosurfactant)	Biosurfactant: Soil	0.000
	Soil: Solvent	0.102
	Type of solvent	0.000
	Temperature (°C)	0.164