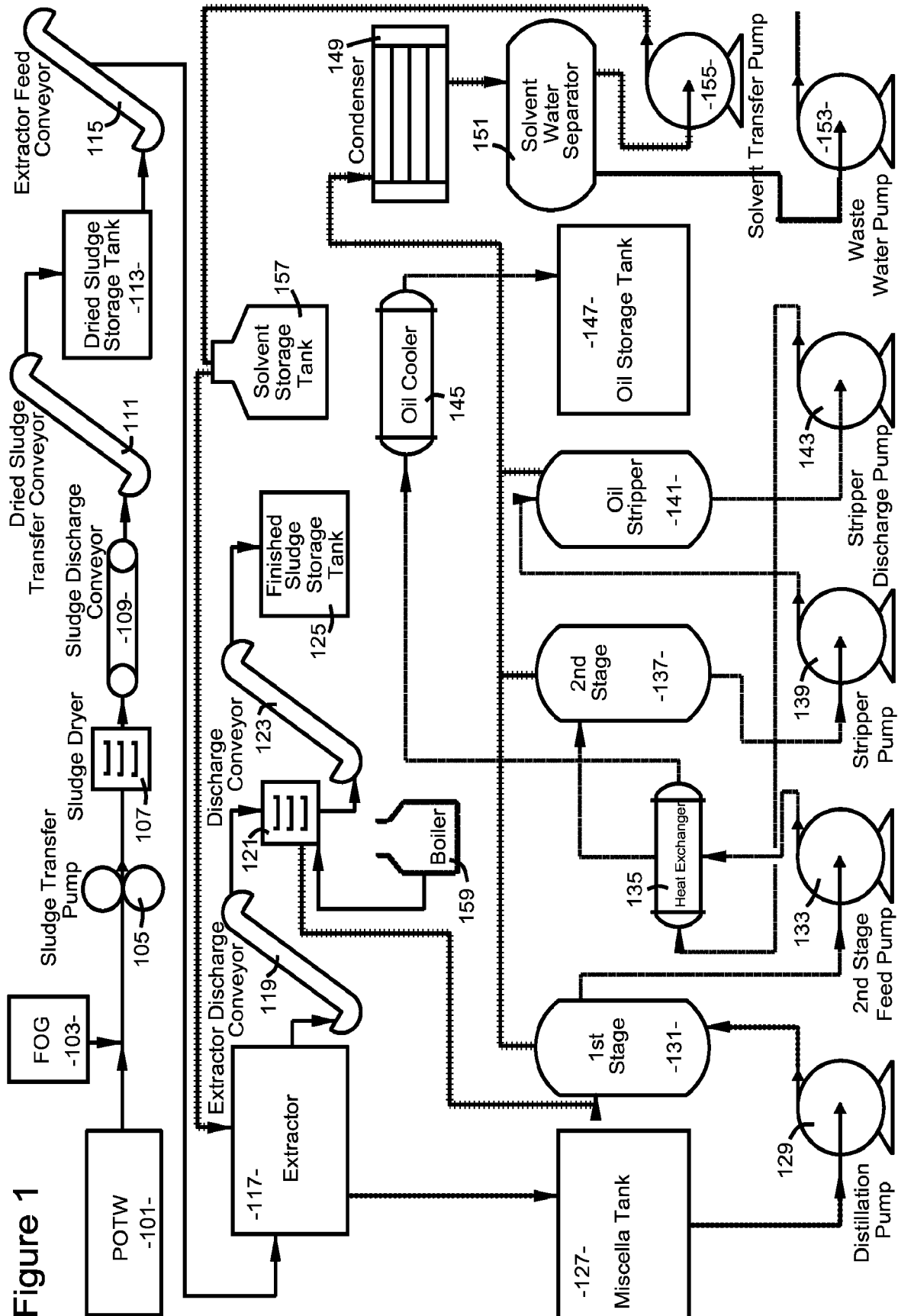




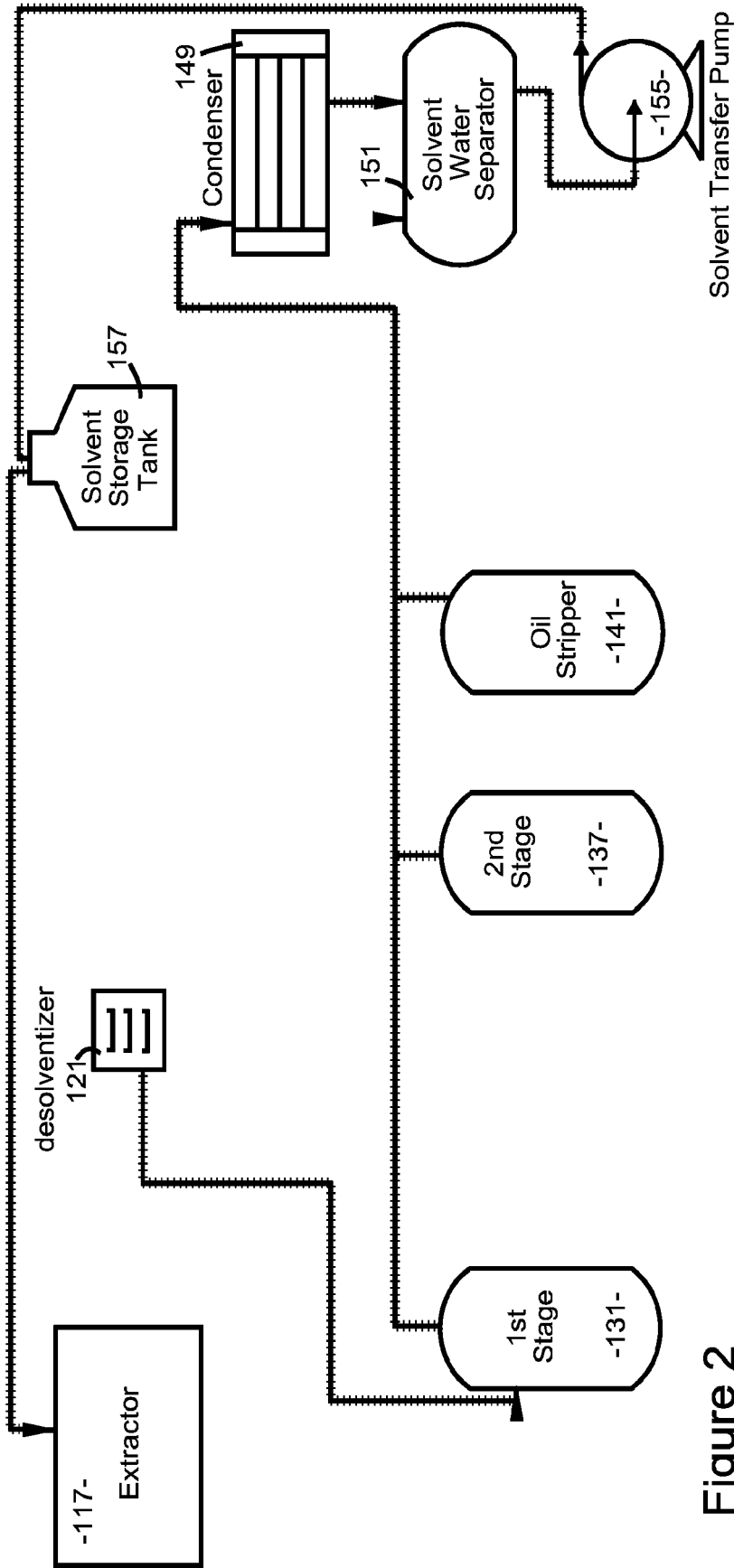


Figure 2

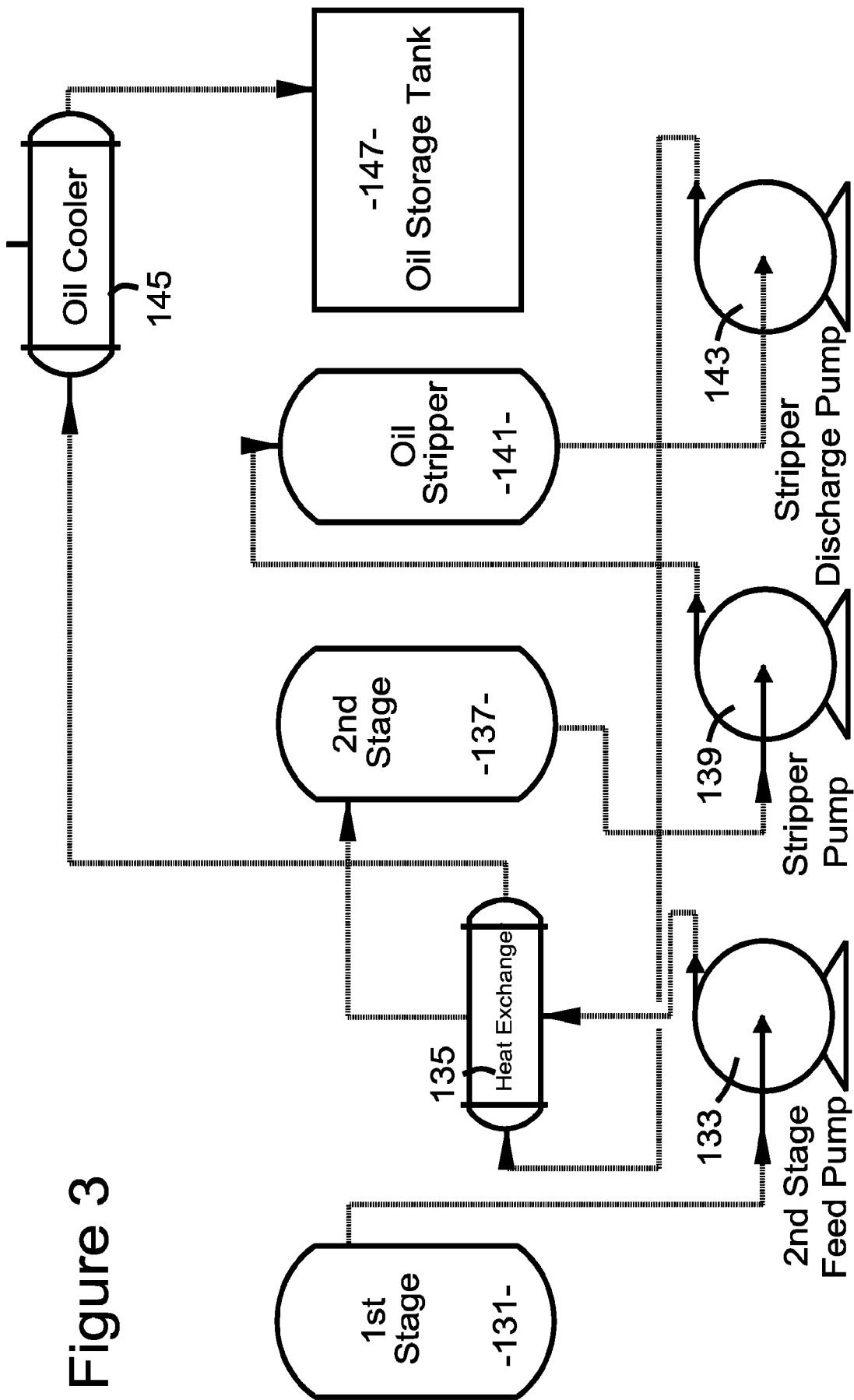


Figure 3

Figure 4

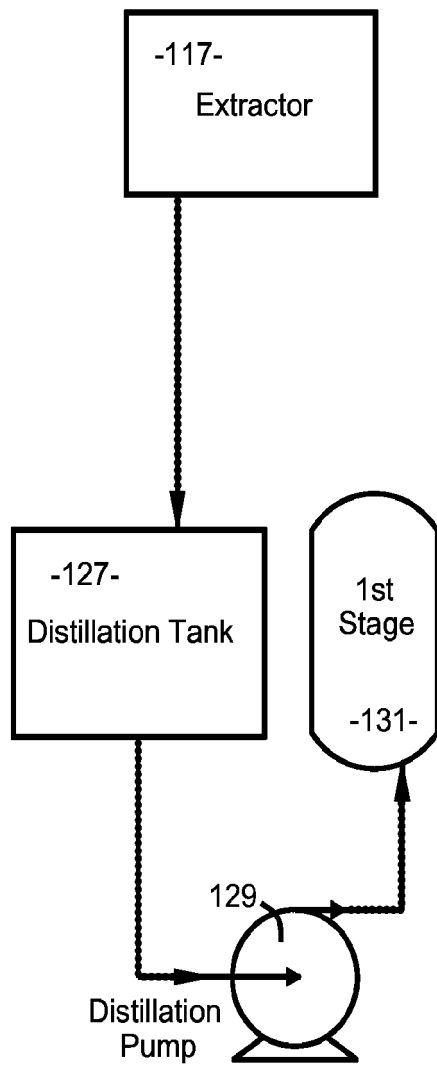


Figure 5

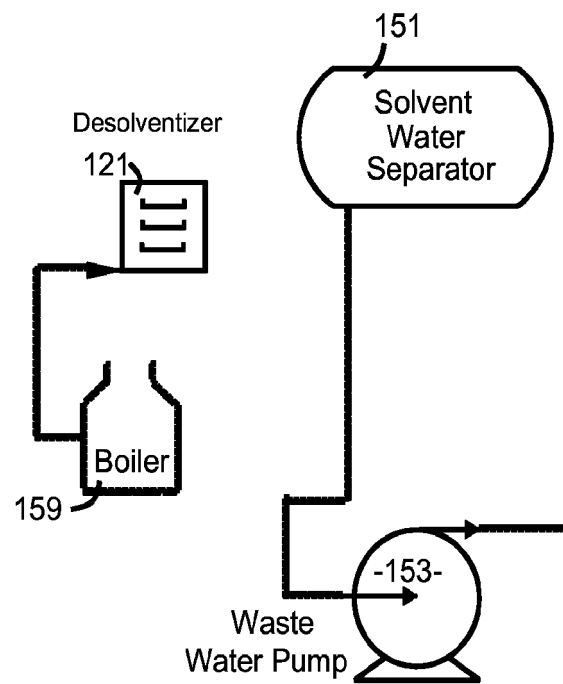


FIGURE 6

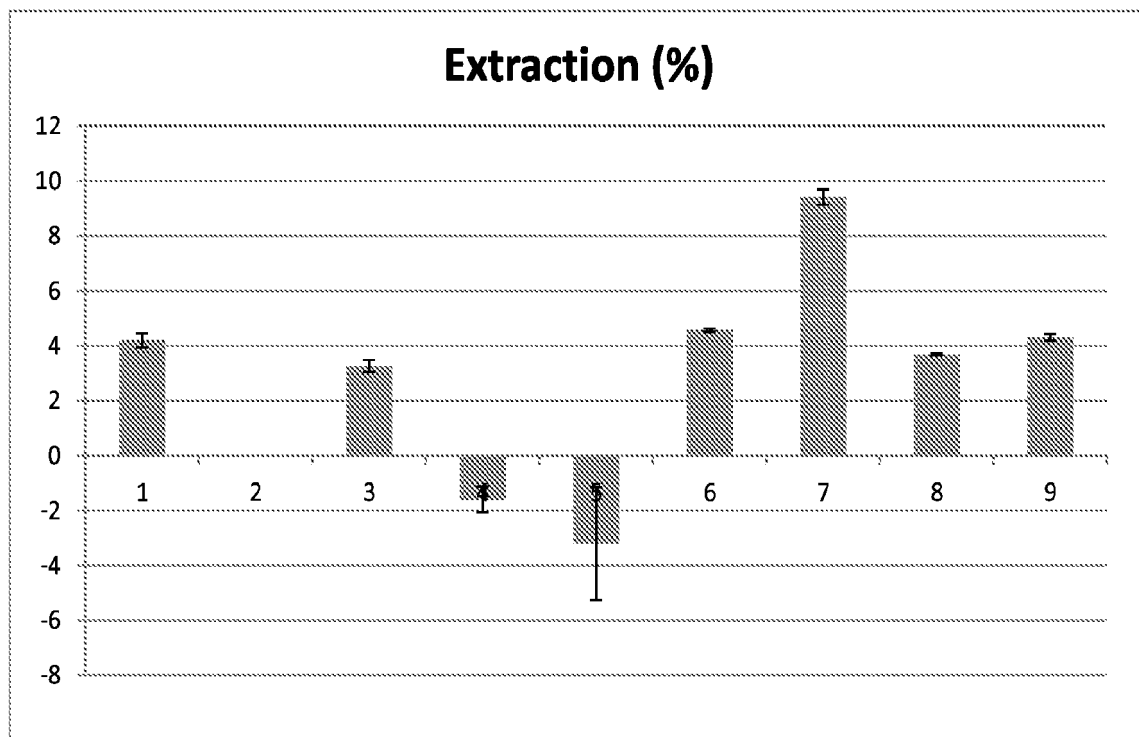
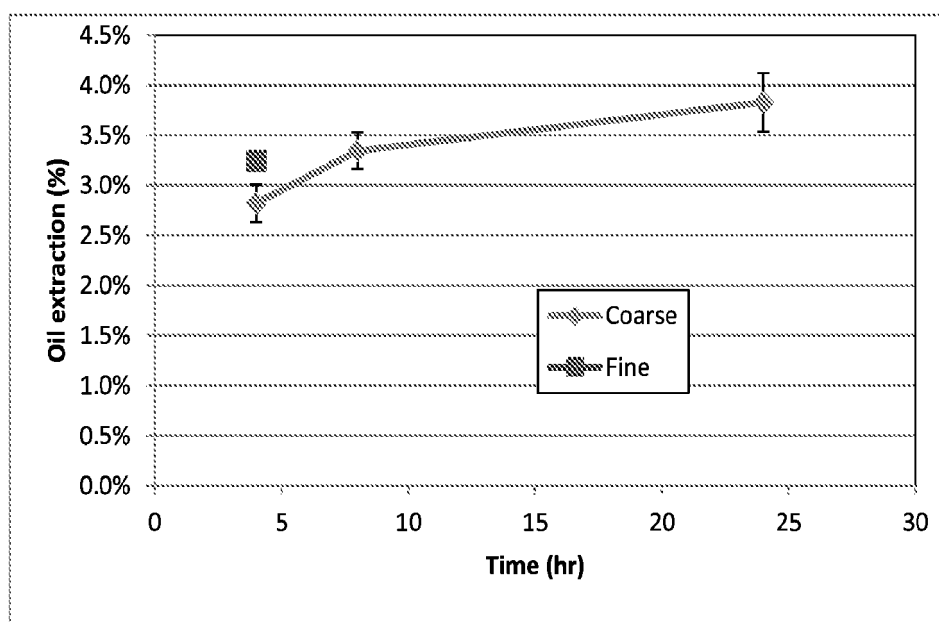
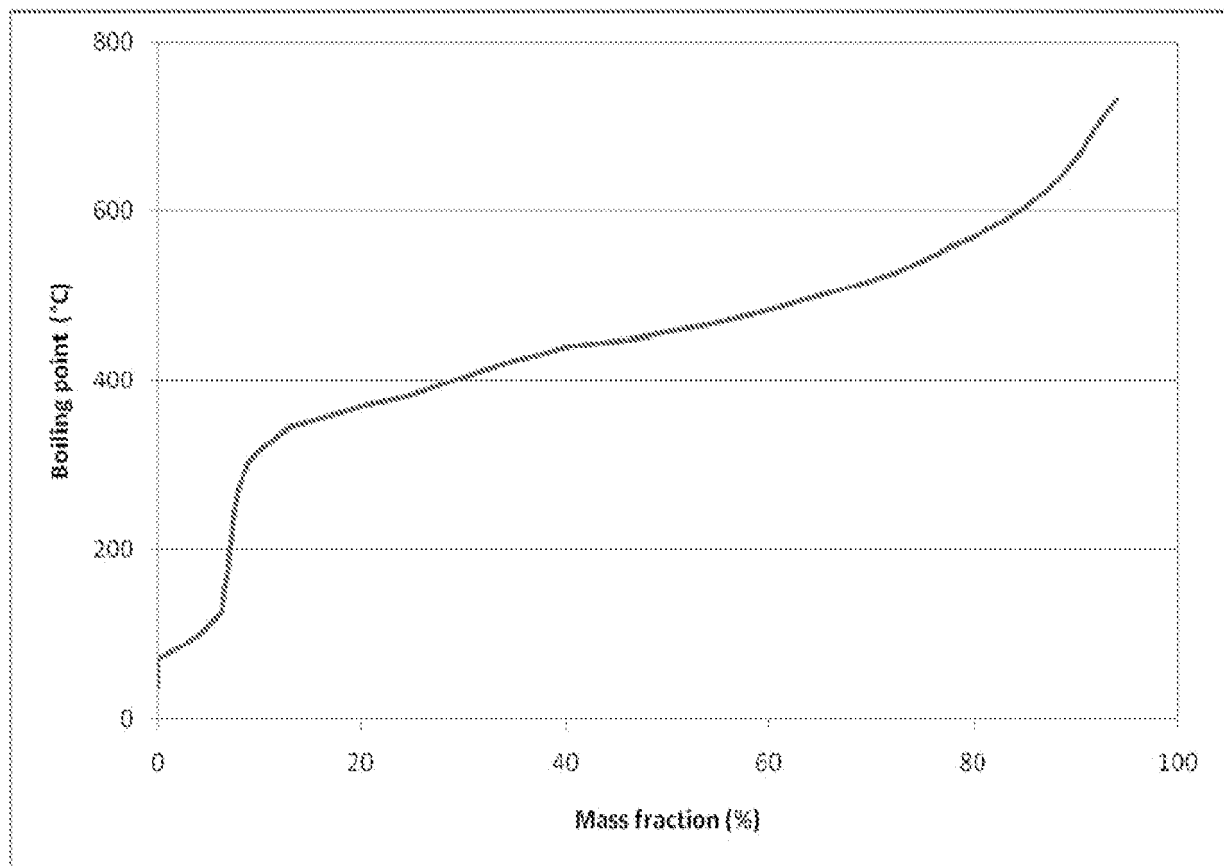
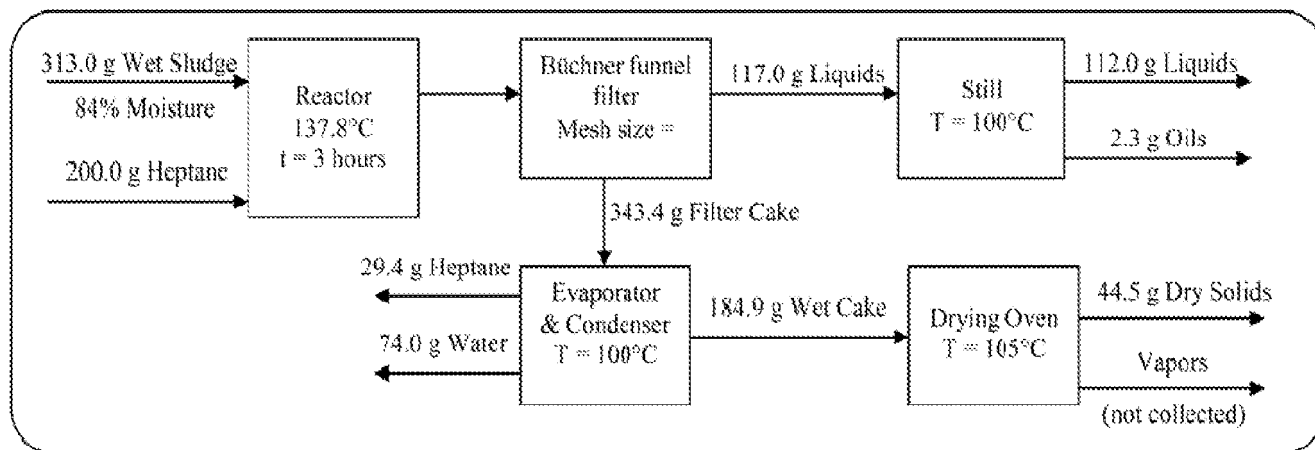


Figure 7



**Figure 1.** Normal boiling curve**Figure 8**



Block flow diagram detailing the mass balances at each step of the extraction process

Figure 9

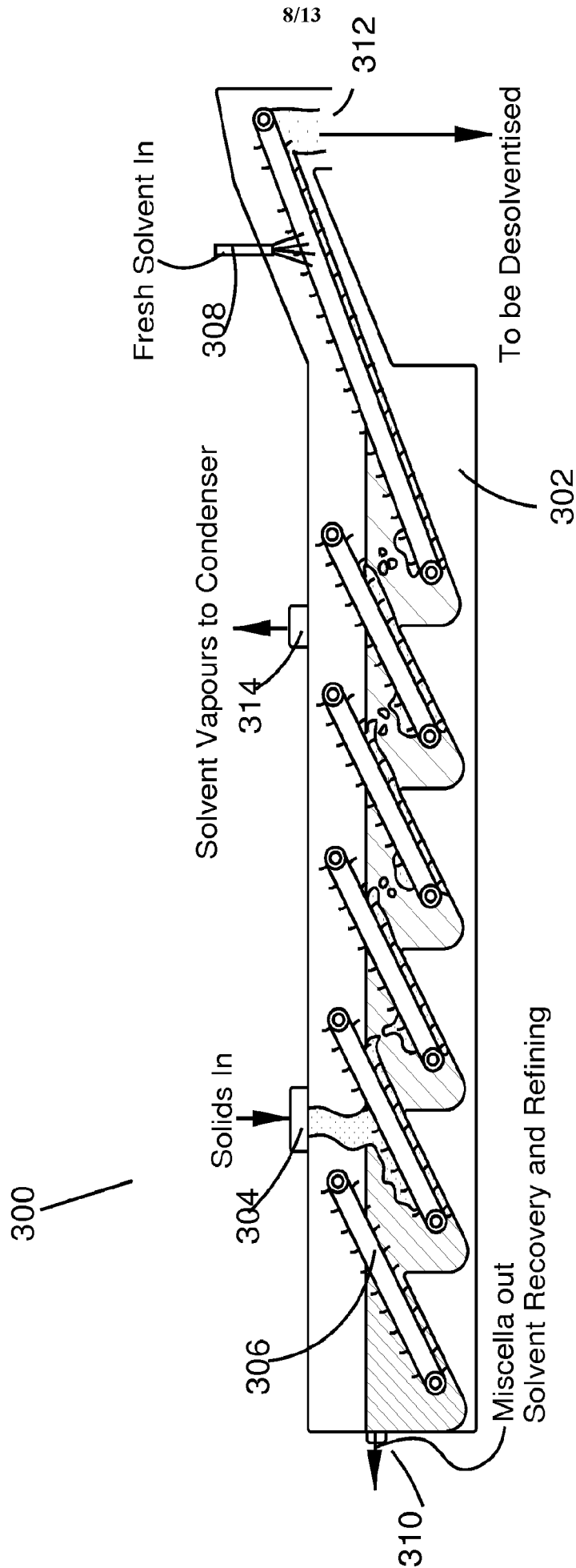


Figure 10

	Factor	P-Value
A	Mixing Speed	0.292
B	Time	0.003
C	Solvent Ratio	0.708
D	Solvent	0.277
E	Particle size	0.042
F	Temperature	0.349

Table 4: P-values signifying the probability of each factor *not* showing a significant effect on extraction percentage

Run	Solvent	Particle Size	Time	Solvent Ratio	Temperature	Extraction Percentage
1	Ethyl Acetate/Cyclohexane	<1 mm	3 hr	4:1	138°C	11.9%
2	Ethyl Acetate	<1 mm	3 hr	4:1	138°C	11.8%
3	Cyclohexane	<1 mm	3 hr	4:1	138°C	9.3%
4	Ethyl Acetate	0.5-3 mm	3 hr	4:1	138°C	9.0%
5	Ethyl Acetate/Cyclohexane	0.5-3 mm	1 hr	4:1	138°C	5.1%
6	Ethyl Acetate/Cyclohexane	0.5-3 mm	3 hr	4:1	138°C	8.4%
7	Ethyl Acetate	0.5-3 mm	1 hr	4:1	138°C	6.8%
8	Ethyl Acetate	0.5-3 mm	3 hr	4:1	121°C	6.4%

Table 5: Conditions for ethyl acetate and cyclohexane extraction experiments

In application as table

3

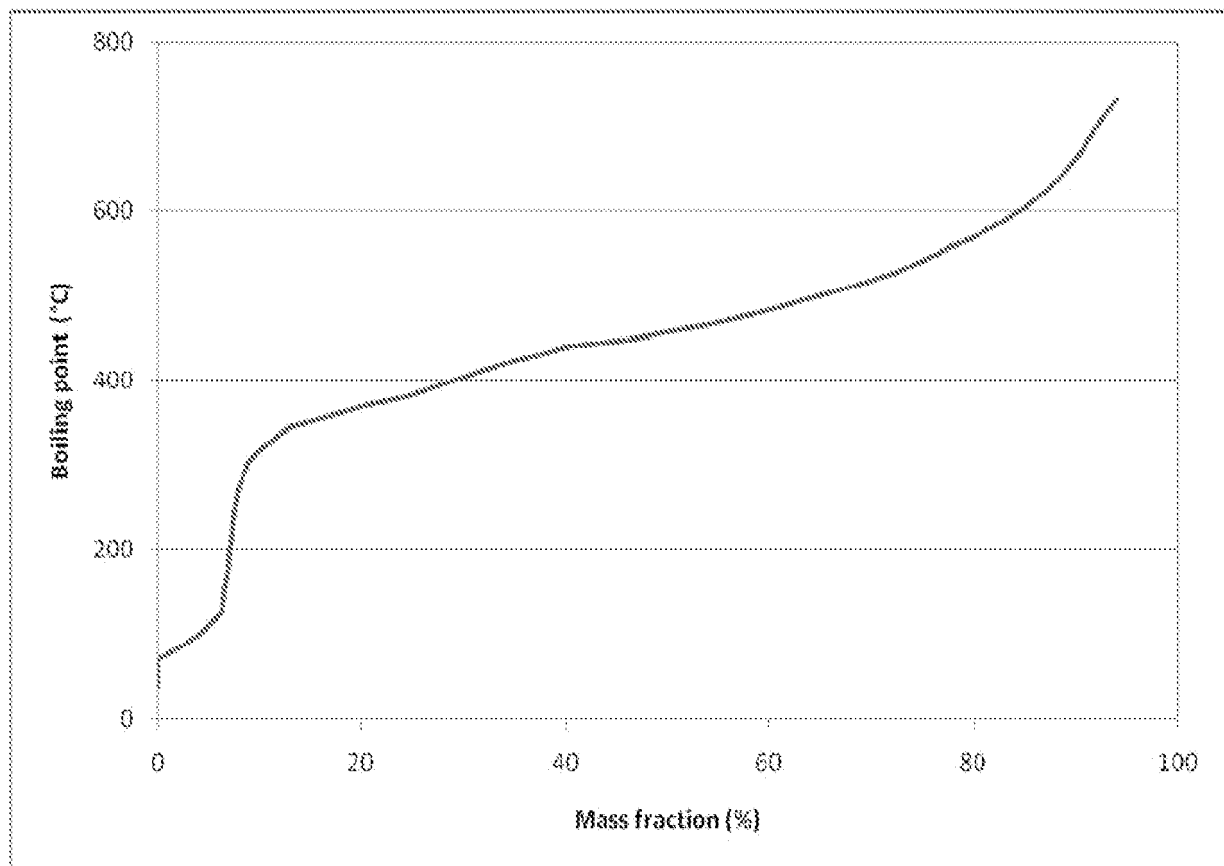


FIGURE 8

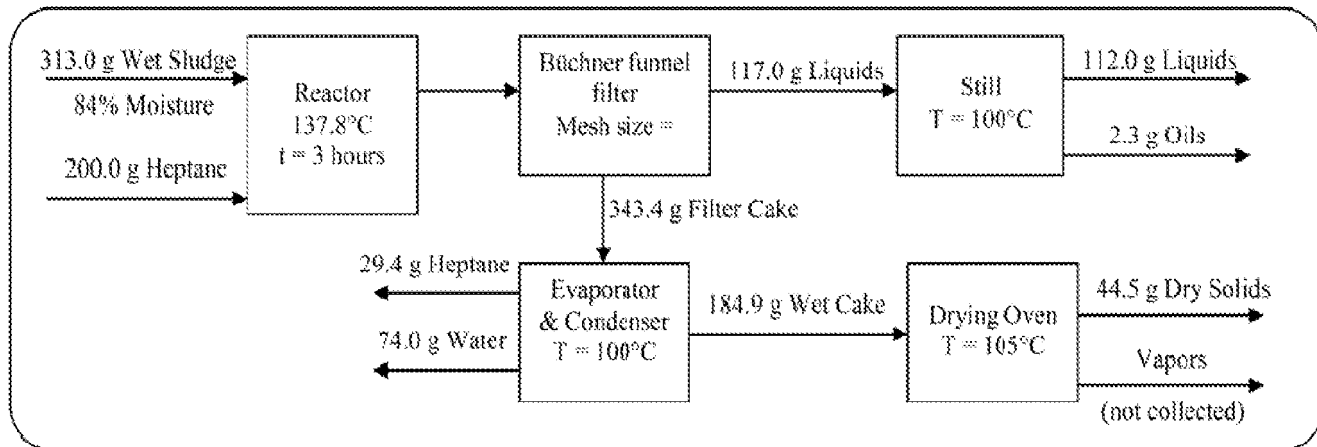


FIGURE 9

Process Step	Mass In	Mass Out	Mass Loss
Reactor/Funnel	513.0 g	460.4 g	52.6 g
Still	117.0 g	114.3 g	2.7 g
Evaporator & Condenser	343.4 g	288.3 g	55.1 g

Table 6: Mass balances for each step in the wet sludge extraction

Solvent	δ_d	δ_p	δ_h	Ra (oleic acid)	Ra (stearic acid)
Heptane	15.3	0.0	0.0	6.565	6.719
Ethyl Acetate	15.8	5.3	7.2	2.893	2.809
n-Propanol	16.0	6.8	17.4	12.468	12.419
Oleic acid	16.2	3.1	5.5	-	-
Stearic acid	16.3	3.3	5.5	-	-

Table 7: Hansen Solubility Parameters for Solvents and Naturally-Occurring Fatty Acids

(Hansen, 2000)