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Sample Preparation

All collectors in the xanthate and derivatives were first weighted in a water filled beaker. The solution was dispersed in the feed tank using a strong water jet, then stirred for five minutes before pumping into the flotation column.

Xanthate and Derivatives Collector

Xanthate SIBX 90%

For SIBX 90%, at J_g of 1 cm/s, no hydrodynamic properties was observed in all concentration tested. Experimental results are shown in Table 1. No froth layer was observed, a mono layer of constant bursting bubbles were observed for all concentration tested. Very large bubbles were observed in the pulp zone with no apparent reduction in bubble size. Gas holdup further confirmed this observation as the gas holdup for all concentration tested remained similar to that of pure water and was not affected by increasing SIBX 90% concentration, as shown in Figure 1.

Table 1 Experimental results of SIBX 90% at J_g 1.0 cm/s

Conc (ppm)	Run 1		Run 2	
	Eg (%)	Hf (cm)	Eg (%)	Hf (cm)
5	4.62	0.2	4.59	0.2
10	4.58	0.2	4.60	0.2
12.5	4.61	0.2	4.60	0.2
15	4.48	0.2	4.53	0.2
20	4.41	0.2	4.57	0.2
30	4.55	0.2	4.61	0.2

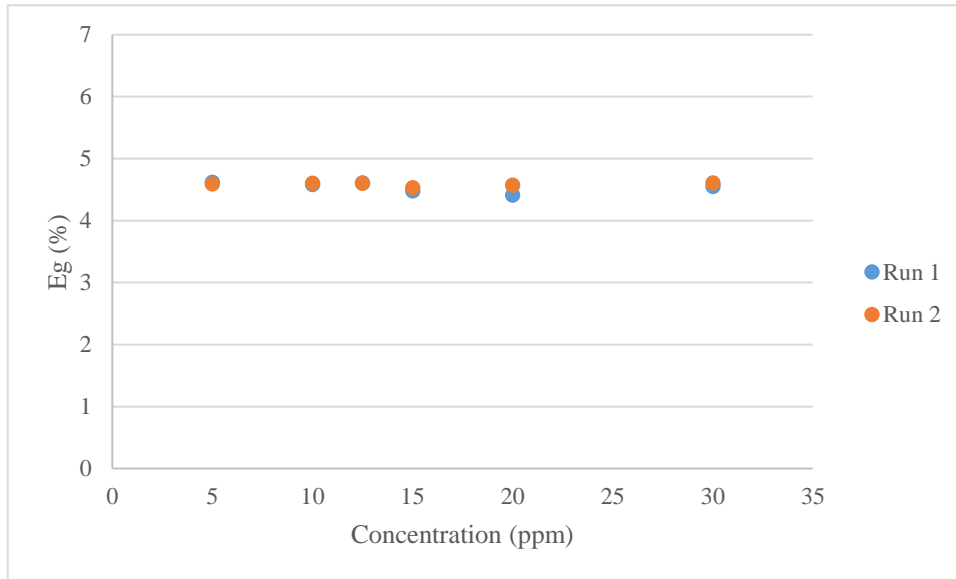


Figure 1 Gas holdup versus Concentration for SIBX 90% at 1 cm/s Jg

Flottec X60-01

For Flottec X60-01, similar to the xanthate SIBX 90%, no hydrodynamic properties were observed. Experimental results are shown in Table 2. No froth layer was observed, only a single layer of bursting large bubbles was observed. Similar gas holdup property compare to SIBX 90% was observed where solution gas holdup was slightly higher than that of water and remained independent of the collector concentration, as shown in Figure 2.

Table 2 Experimental results of Flottec X60-01 at Jg 1.0 cm/s

Conc (ppm)	Run 1		Run 2	
	Eg (%)	Hf (cm)	Eg (%)	Hf (cm)
0	4.13	0.4		
5	4.56	0.2	4.55	0.2
10	4.56	0.2	4.58	0.2
12.5	4.52	0.2	4.55	0.2
15	4.59	0.2	4.53	0.2
20	4.46	0.4	4.60	0.4
30	4.50	0.4	4.56	0.4

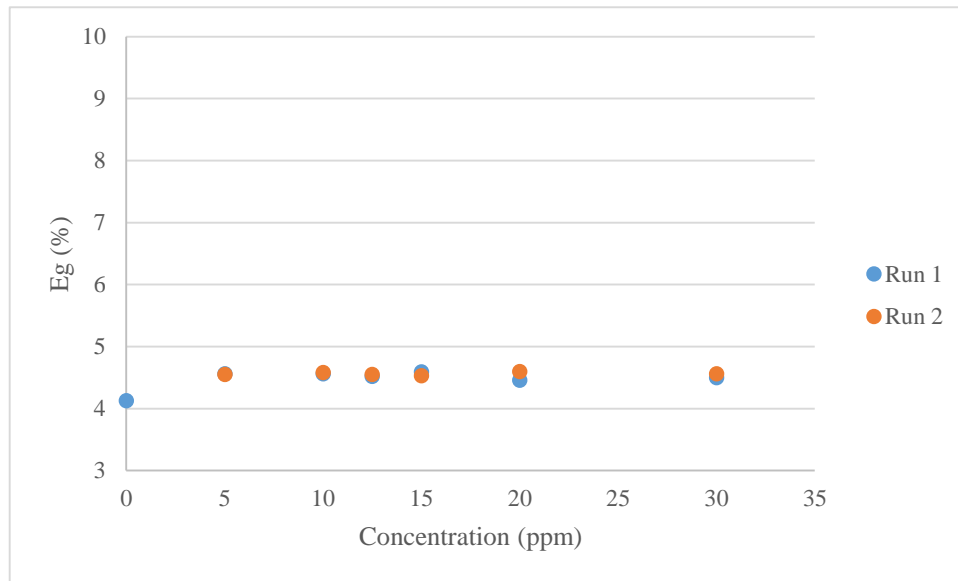


Figure 2 Gas holdup versus Concentration for Flottec X60-01 at 1 cm/s Jg

Flottec 34

For Flottec 34, limited hydrodynamic properties were observed. Experimental results are shown in Table 3. Hydrodynamic curve is shown in Figure 3. The slope of the hydrodynamic curve is very flat compare to even frother like MIBC. With increasing concentration, the collector reduced bubble size significantly, resulting in the increase of gas holdup, as shown in Figure 4, however, almost no froth layer was observed at the surface. Size of bubbles near in the froth layer were small but significantly larger than size of bubbles in the pulp zone. Furthermore, some yellow precipitate were observed near the froth layer, suggesting that collector might be coming out of solution due to their high hydrophobicity.

Table 3 Experimental results of Flottec 34 at Jg 1.0 cm/s

Conc (ppm)	Run 1		Run 2	
	Eg (%)	Hf (cm)		
5	6.53	0.6	6.47	0.4
10	8.82	1.0	8.67	1.0
15	9.15	1.0	9.45	1.0
20	10.05	1.0	10.54	1.2
30	14.02	1.4	14.13	1.4

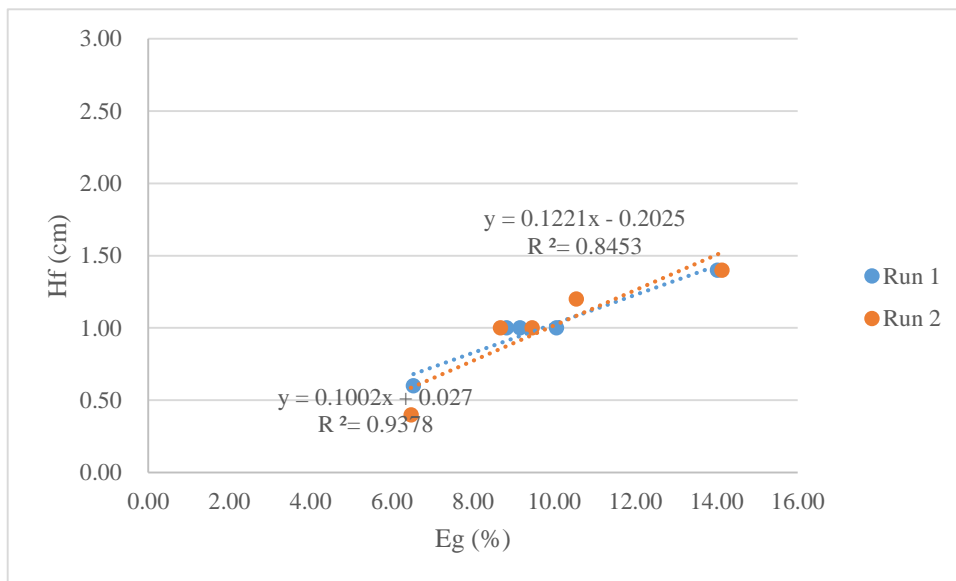


Figure 3 Hydrodynamic Curve for Flottec 34 at 1 cm/s Jg

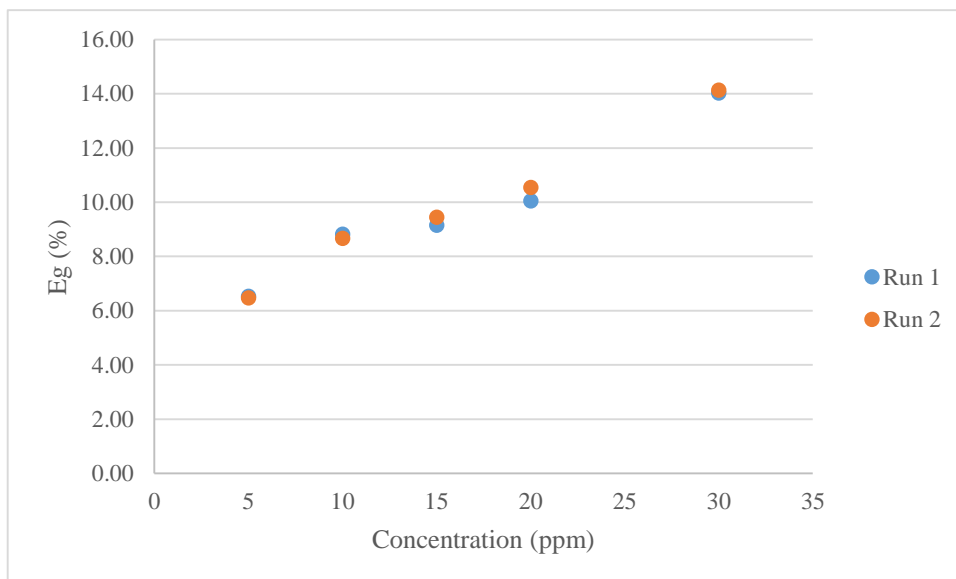


Figure 4 Gas holdup versus Concentration for Flottec 34 at 1 cm/s Jg

Flottec 305

For Flottec 305, no hydrodynamic properties were observed. Experimental results are shown in Table 4. Air slug formation in the pulp zone were observed at all concentration tested, as shown in Figure 5. Due to the formation of air slugs, gas holdup for all concentration were lower than that of water, and was decreasing with increasing collector concentration, as shown in Figure 6.

Table 4 Experimental results of Flottec 305 at Jg 1.0 cm/s

Conc (ppm)	Run 1		Run 2	
	Eg (%)	Hf (cm)	Eg (%)	Hf (cm)
0	4.15	0.4		
5	4.11	0.2	4.03	0.2
10	3.68	0.2	3.71	0.2
15	3.59	0.2	3.62	0.2
20	3.47	0.2	3.52	0.2
30	3.28	0.2	3.15	0.2

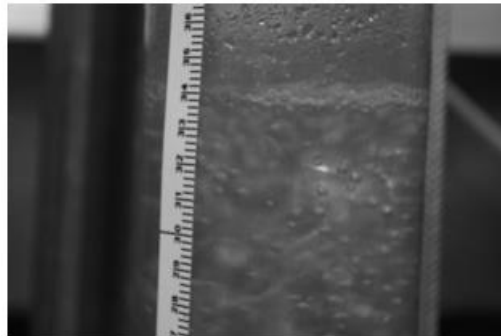


Figure 5 Air slugs formation in Flottec 305 at 5 ppm

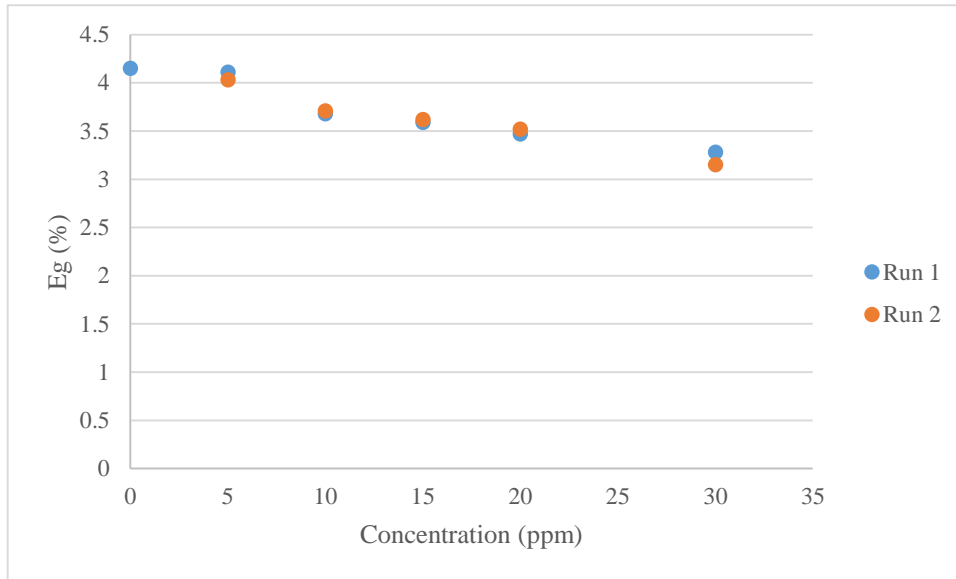


Figure 6 Gas holdup versus Concentration for Flottec 34 at 1 cm/s Jg

Flottec 1234

For Flottec 1234, froth formation was observed at concentration higher than 10 ppm and was increasing with increasing collector concentration. Experimental results are shown in Table 5. The hydrodynamic curve is shown in Figure 7 and gas holdup curve in Figure 8. A sample of the froth layer is illustrated in Figure 9. The froth layer appeared similar to a froth layer of a conventional frother. However, it had a rather low froth persistence: Figure 9 shows a froth layer of around 7.5 cm at 12.5 ppm after 30 minutes compare to 16.4 cm of froth after 4 minutes.

Table 5 Experimental results of Flottec 1234 at Jg 1.0 cm/s

Conc (ppm)	Run 1		Run 2	
	Eg (%)	Hf (cm)	Eg (%)	Hf (cm)
5	6.04	0.6	6.14	0.4
10	10.37	2.6	10.27	3.0
12.5	13.06	16.4	13.11	18.4
15	13.55	32.0	13.08	30.8
20	14.42	49.0	14.62	48.6
30	14.89	57.0	15.13	61.0

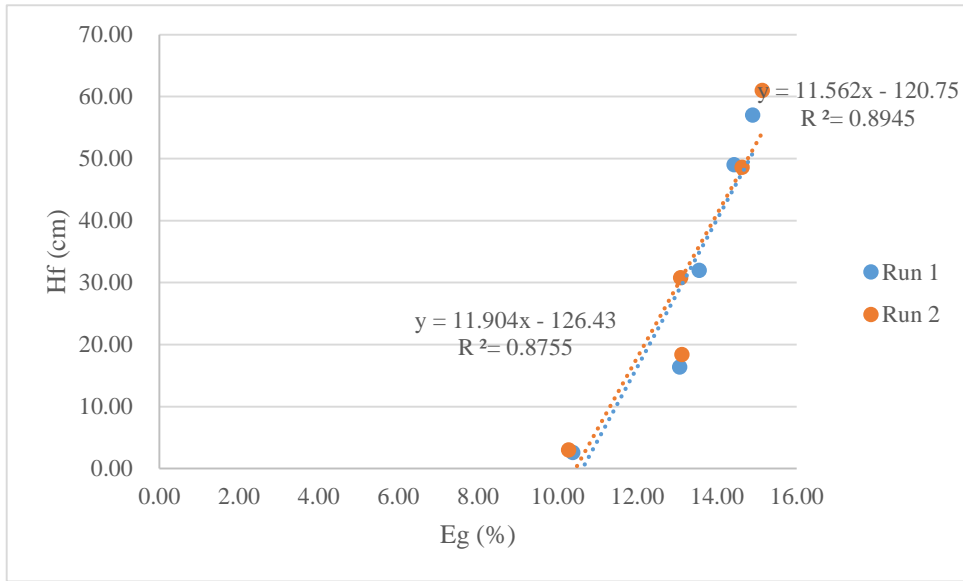


Figure 7 Hydrodynamic curve for Flottec 1234 at 1 cm/s Jg

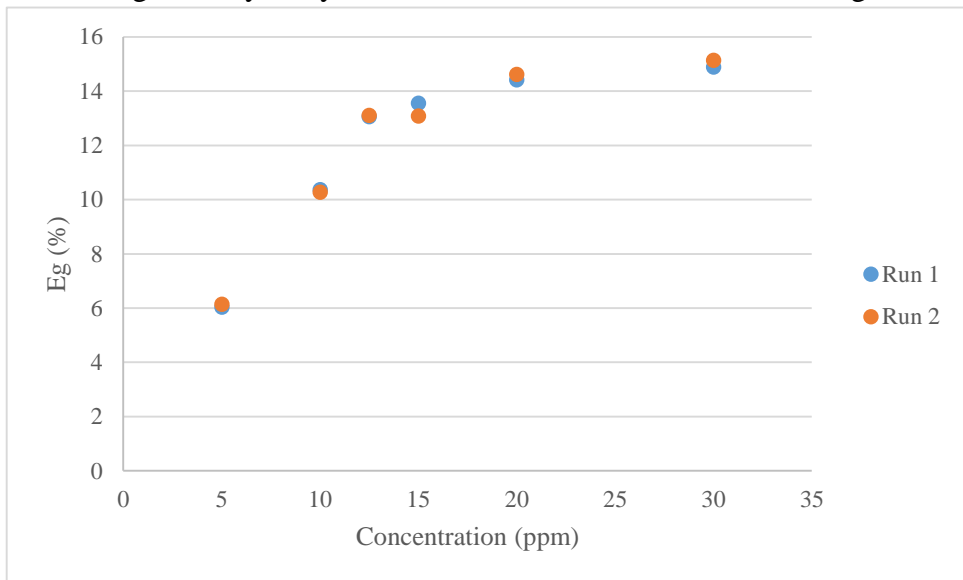


Figure 8 Gas holdup versus Concentration for Flottec 1234 at 1 cm/s Jg

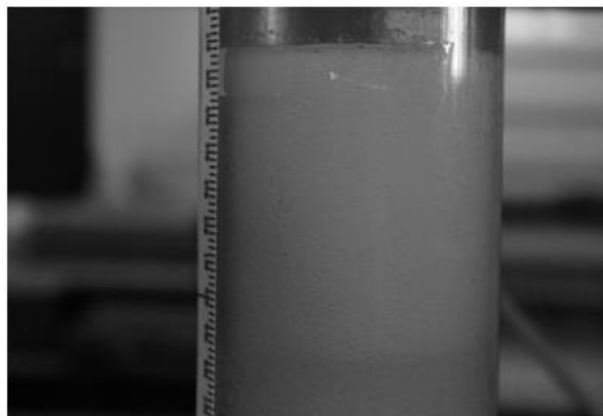


Figure 9 Froth layer of Flottec 1234 at 12.5 ppm after 30 minutes at 1 cm/s Jg

Flottec 1344

For Flottec 1344, some degree of hydrodynamic properties were observed. Experimental results are shown in Table 6. At Jg of 1 cm/s, an increase in gas holdup was observed with increasing concentration, as illustrated in Figure 10. However, the froth layer remain at around 1 cm even at concentration up to 20 ppm. It was initially thought that at higher air rate the collector might give a bigger froth. Results turned out that at higher air rate (e.g. Jg 1.75 cm/s), gas holdup increased significantly but the froth height remained relatively the same after 4 minutes. After 10 minutes, however, froth layer at collector concentration higher than 20 ppm at Jg 1.75 cm/s increased significantly compare to 4 minutes, topped at 2.4 cm and 4.8 cm compare to 1.0 cm and 1.6 cm after 4 minutes. Two distinct gas holdup plateau can be observed, where gas holdup first increased, slowed down to a plateau, then increased again and stopped at a higher plateau region, as illustrated in Figure 11. Figure 12 shows the hydrodynamic curves for Flottec 1344 at both 1.0 and 1.75 Jg. For both air rate, the collector gave a wide range of gas holdup with almost constant froth height.

Table 6 Experimental results of Flottec 1344 at Jg 1.0 cm/s

Conc (ppm)	Jg 1.75 cm/s		Jg 1.0 cm/s	
	Eg (%)	Hf (cm)	Eg (%)	Hf (cm)
5	10.12	0.6	6.34	0.4
10	11.83	0.8	7.23	0.6
12.5	13.41	0.8	8.10	0.6
15	15.76	1.0	8.94	0.8
20	17.55	1.2	10.14	1.0
30	19.20	1.6		

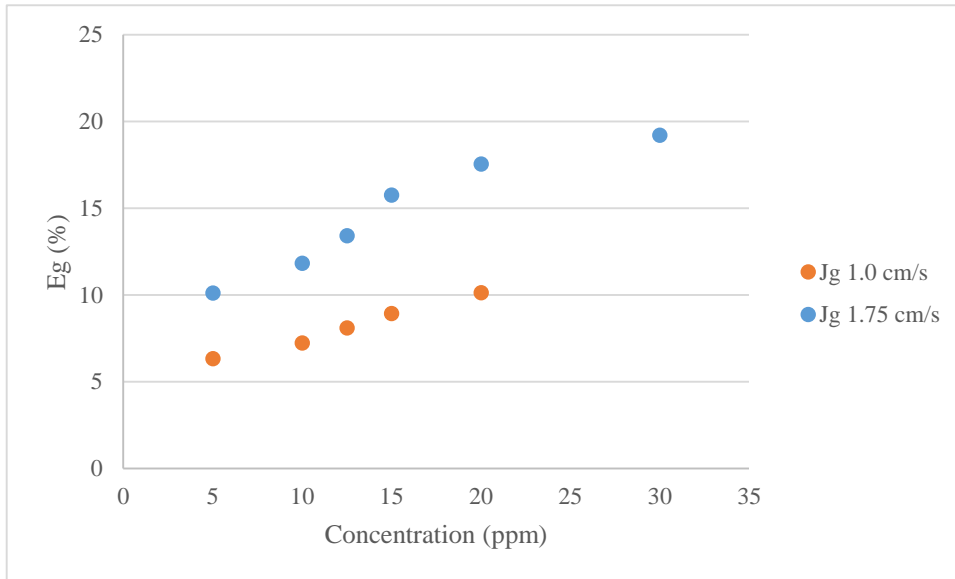


Figure 10 Gas holdup versus Concentration for Flottec 1344

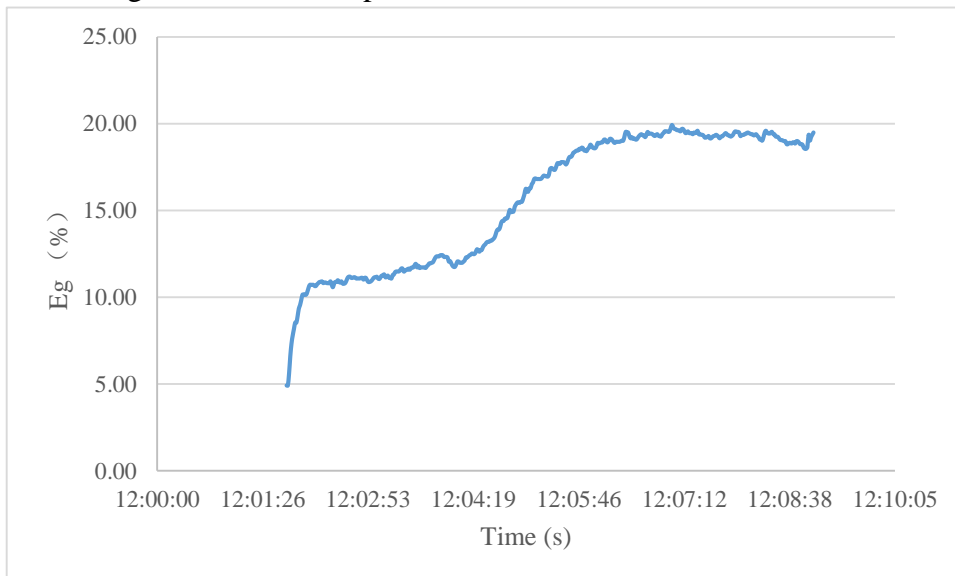


Figure 11 Gas holdup versus time for Flottec 1344 at 15 ppm with Jg 1.75 cm/s

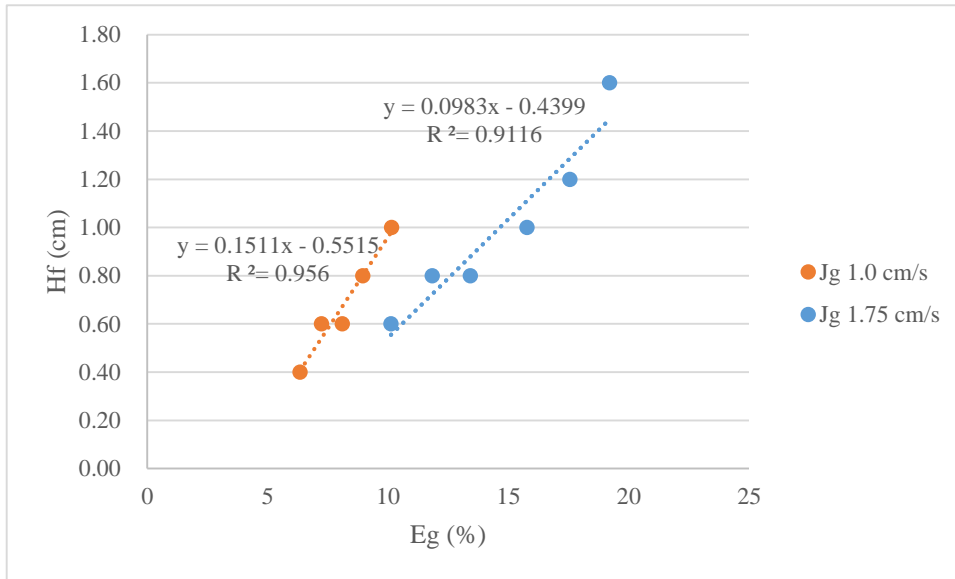


Figure 12 Hydrodynamic curve for Flottec 1344