Chapter IV

EXPERIMENTAL RESULTS

4.1 Determination of Fluidizing Air Velocities

The minimum fluidizing velocitiy for each particle size is calibrated as described in 3.3.1 and data is shown in table 4.1. For each particle size, we can find a curve related the pressure drop across the bed and air velocity for one height of fixed bed, so, for the advantage of reliability, three curves of such relation are found and it observed that each maximum pressure drop of a height of fixed bed gives the value of minimum fluidizing velocity quite close to each other. For convenient keeping up, table 4.1 consists of three parts of data, each part is data for one particle size and will be followed by the figure showing curves plotted from the data in that part. Therefore, fig 4.1 shows how U_{mf} for d_p=0.33cm is determined and so do fig 4.2,4.3 for d_p = 0.51 0.64 cm. respectively. All U_{mf} obtained will be compared to those calculated by different equations from theory and the fitness is clarified in the next chapter. The minimum fluidizing velocities for d_p = 0.33,0.51 and 0.64 cm. from calibration are 4.9 , 5.1 and 5.7 m./min correspondingly.

The superficial air velocity for each particle size is measured at the enlarged part of fluidizing column by anaemometer. The air velocity observed is strong enough to fluidize the fixed bed of 2.5 cm. height to the fluidized bed of 5.0 cm. height approximately. Data recorded is shown in table 4.2 which consists of 3 parts, each part for one particle size. For d_p = 0.33 cm the first or prior average of air velocities are 13.1,13.0,13.2 m/min. so gives the final average 13.1m/min. which is to be reimbursted to the actual velocity at the pervious bed as 31.4 m/min or 52.4 cm/sec. Similarly, the superficial air velocity for d_p = 0.51 and 0.64 cm are found to be 66.8 and 105.7 cm/sec. respectively, besides that, in order to observe the uniformity of fluidizing air, the degree of uniformity is expressed in term of deviation percentage which shows how much different is between the average value and the nearest,

Table 4.1 Determination of Minimum Fluidizing Velocity (U_{mf}) Fluidizing Column of 3.75 in diameter or 0.0767ft^2 cross sectional area.

d_p (cm)	Height of bed (cm)	Pressure drop (mm H_2O)	Volume of Air Flow (10^{-1} ft^3/min) 1st	2nd	3rd	av	Air Velocity (ft/min)
0.33	28	1.0	6.0	6.0	6.0	6.0	7.8
		2.0	8.0	8.9	8.0	8.3	10.8
		2.5	11.0	11.0	11.0	11.0	14.3
		3.2	12.0	12.0	12.0	12.0	15.6
		4.0	12.3	12.5	12.3	12.4	16.2
		4.0	13.0	13.0	13.0	13.0	16.9
		4.0	21.5	21.5	21.5	21.5	28.0
		4.0	26.5	26.5	26.5	26.5	34.5
	47.5	1.5	7.7	7.7	7.7	7.7	10.0
		3.0	10.5	10.5	10.5	10.5	13.7
		3.5	10.8	10.8	10.8	10.8	14.1
		5.0	11.7	11.7	11.7	11.7	15.3
		6.0	12.0	12.0	12.0	12.0	15.7
		6.0	13.2	13.2	13.1	13.2	17.2
		6.0	19.6	19.8	19.8	19.6	25.5
		6.0	25.9	26.0	25.8	25.9	33.7
	61	1.0	4.3	3.8	3.8	4	5.2
		2.0	6.6	6.6	6.7	6.6	8.6
		4.0	10.8	10.9	10.6	10.8	14.1
		6.5	11.4	11.6	11.2	11.4	14.8
		8.0	12.0	12.0	12.2	12.1	15.8
		9.0	13.0	13.0	13.0	13.0	16.9
		9.0	18.1	18.0	18.0	18.0	23.7

Table 4.1 (Continued)

d_p (cm)	Height of bed (cm)	Pressure drop (mm.)	Volume of Air Flow (10^{-1} ft^3/min) 1st	2nd	3rd	av	Air Velocity (ft/min)
0.51	28	1.5	8.7	8.8	8.8	8.8	11.5
		2.5	10.5	10.5	10.5	10.5	13.7
		3.5	12.8	12.8	13.0	12.9	16.8
		4.0	13.0	13.0	13.0	13.0	16.9
		4.0	14.0	13.7	14.0	13.9	18.1
			22.6	22.4	22.7	22.6	29.5
	47.5	2.5	7.5	8.0	8.0	7.9	10.3
		4.0	10.5	11.5	10.5	10.8	14.1
		6.0	11.5	12.5	12.2	12.1	15.7
		7.0	13.1	13.0	12.6	12.9	16.8
		7.0	13.0	13.0	13.0	13.0	16.9
		7.0	13.4	13.4	13.4	13.4	17.5
			19.4	19.8	19.7	19.6	25.6
	65	2.0	6.0	6.0	6.0	6.0	7.8
		4.0	12.0	11.0	11.5	11.5	14.9
		5.0	12.0	12.0	12.0	12.0	15.7
		6.5	12.0	12.0	12.0	12.0	15.7
		7.5	12.4	12.7	12.1	12.4	16.2
		9.0	12.9	12.7	12.1	12.9	16.8
		1.0	18.0	17.9	18.0	17.9	23.4
		1.0	21.5	21.4	21.0	21.3	27.8

Table 4.1 (Continued)

d_p (cm)	Height of bed (cm)	Pressure drop ($mm.H_2O$)	Volume of Air Flow (10^{-1} ft^3/min) 1st	2nd	3rd	av	Air Velocity (ft/min)
0.64	28	0.5	5.5	5.6	5.5	5.5	7.2
		1.0	8.4	8.0	8.5	8.3	10.3
		2.0	10.7	10.5	10.6	10.5	13.7
		2.2	12.7	12.2	12.5	12.5	15.2
		2.2	15.0	15.0	15.0	15.0	19.6
		2.2	23.9	24.2	23.4	23.8	31.0
	54	0.5	6.7	6.9	6.8	6.8	8.9
		2.0	12.2	12.3	12.3	12.3	16.0
		4.0	12.6	12.9	12.8	12.8	16.6
		6.0	13.5	13.5	13.5	13.5	17.6
		8.0	14.4	14.2	14.3	14.3	18.6
		9.0	14.4	14.4	14.4	14.4	18.8
		9.0	16.0	16.0	16.0	16.0	20.9
		9.0	23.3	23.3	23.3	23.3	30.4
	65	0.5	6.9	6.9	6.9	6.9	9.0
		2.0	12.0	12.0	12.0	12.0	15.6
		1.5	12.7	12.6	12.6	12.6	16.4
		2.5	13.0	13.0	13.0	13.0	16.9
		4.5	13.9	14.0	13.8	13.9	18.1
		7.5	14.6	15.0	15.0	15.0	19.0
		9.0	14.7	14.7	14.7	14.7	19.1
		9.0	19.5	19.5	19.5	19.5	25.4

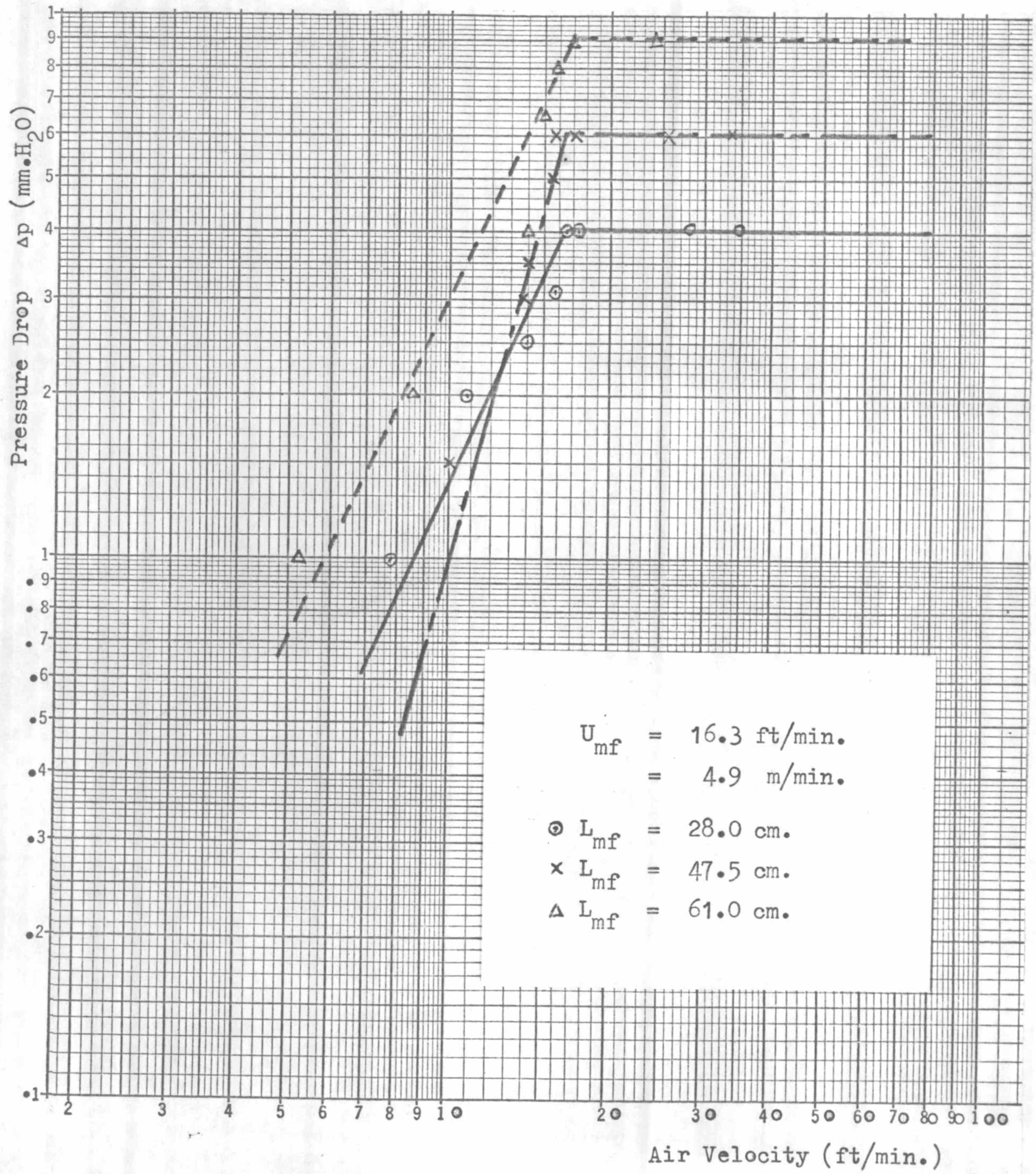

FIG.4.1 MINIMUM FLUIDIZING AIR VELOCITY DETERMINATION FOR $d_p = 0.33$ cm.

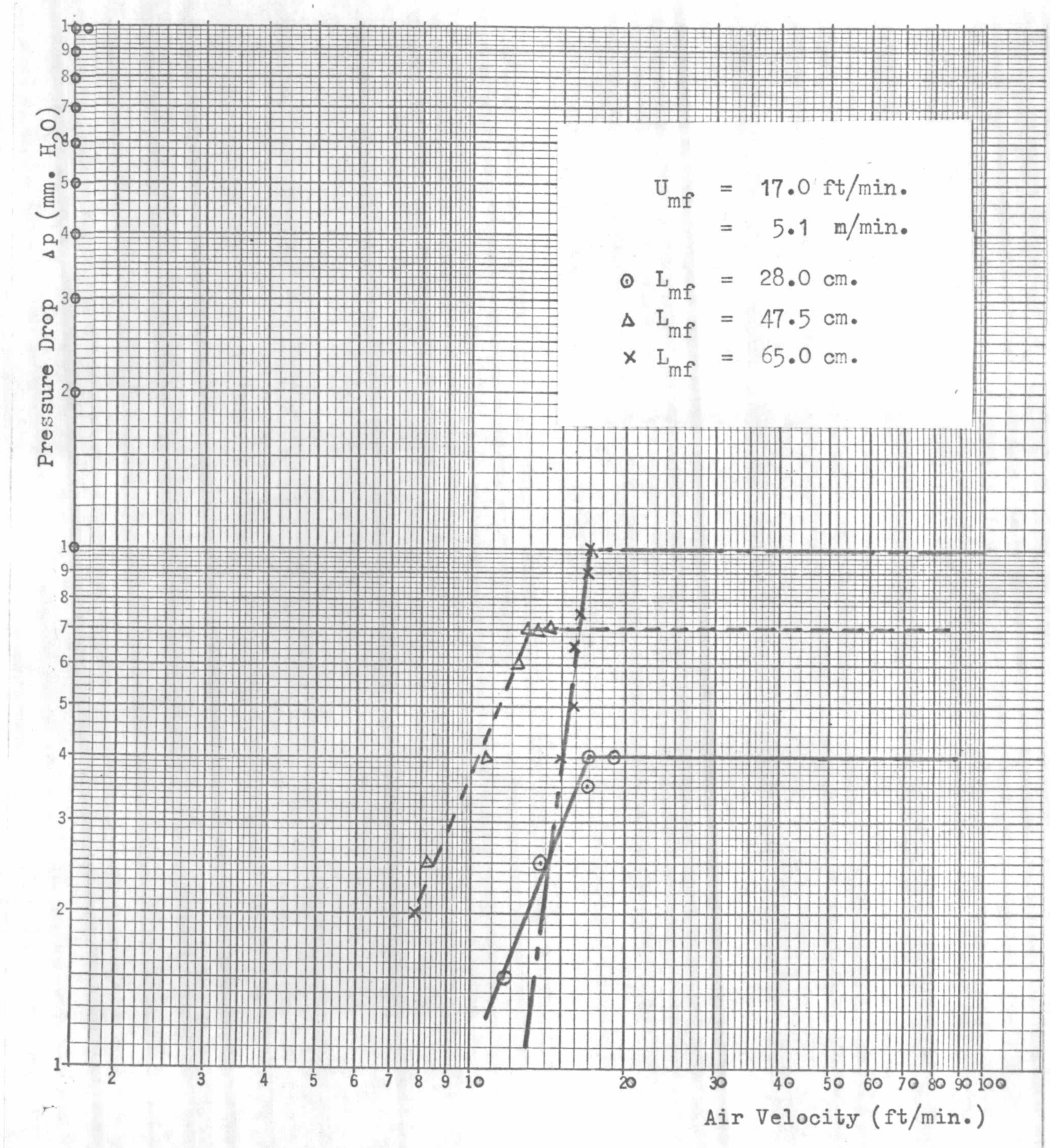

FIG.4.2 MINIMUM FLUIDIZING AIR VELOCITY DETERMINATION FOR d_p = 0.51 cm.

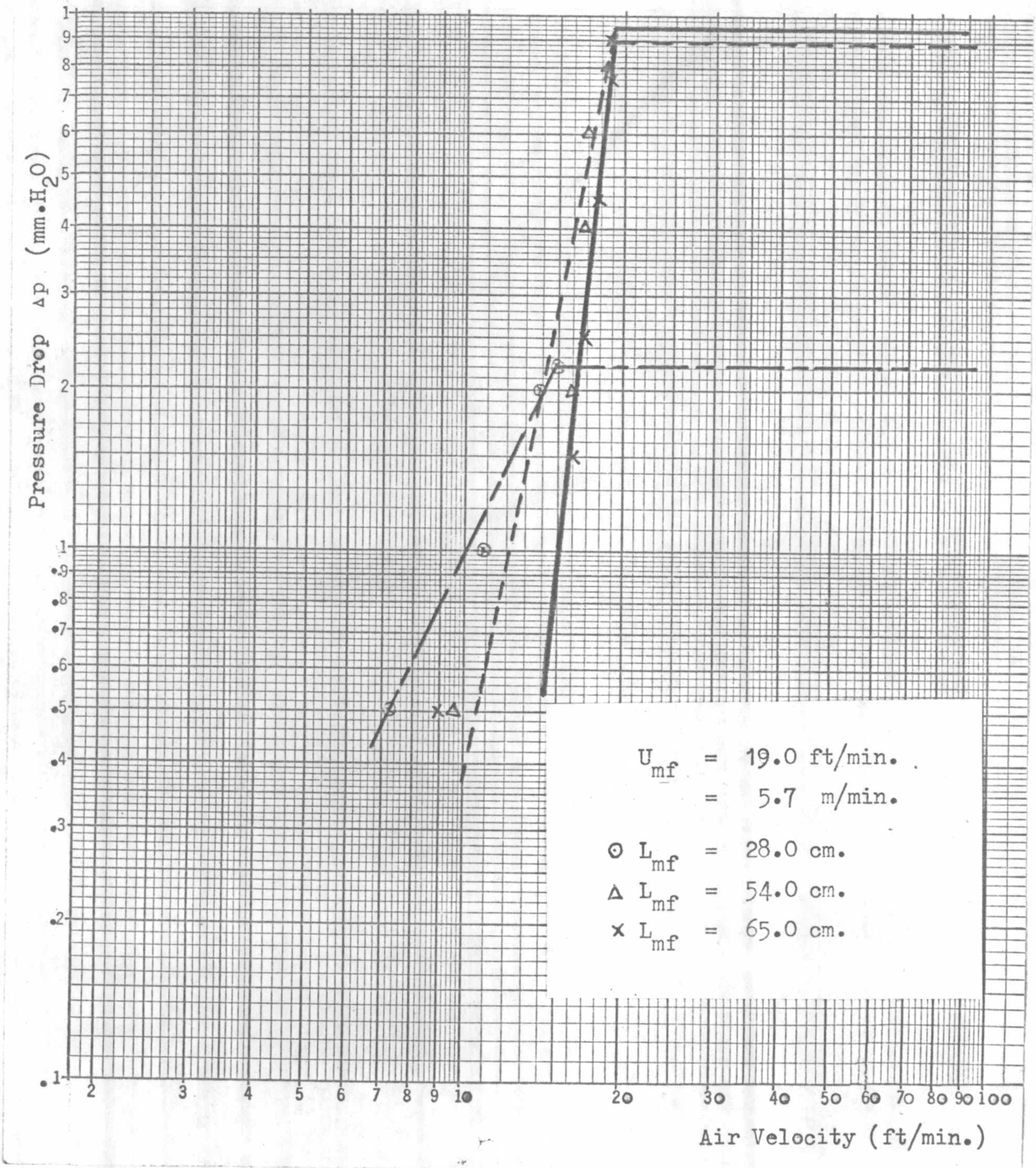

FIG.4.3 MINIMUM FLUIDIZING AIR VELOCITY DETERMINATION FOR d_p = 0.64 cm.

Table 4.2 Superficial Air Velocity Calibration (U_o)

L_{mf} = 2.5 cm L_f = 5.0 cm

d_p (cm)	Scale on bed	Anaemometer Reading								
			Deviation			Deviation			Deviation	
		(m/min)	absolute	%	m/2min	absolute	%	m/3min	absolute	%
0.33	10	11.9	1.2		24.1	1.8		36.3	3.4	8.6
	20	13.1	0.0	0.0	25.3	0.6	2.3	39.5	0.2	0.5
	30	12.1	1.0		24.4	1.5		37.2	2.5	
	40	13.3	0.2		27.5	1.6		42.4	2.7	
	50	14.5	1.4		28.2	2.3		42.8	3.1	
	60	14.8	1.7	12.9	28.4	2.5	9.7	42.3	2.6	
	70	13.4	0.3		26.8	0.9		39.4	0.3	
	80	12.4	0.7		24.5	1.4		40.5	0.8	
	90	11.6	1.5		23.4	2.5	9.7	36.8	0.9	
Reading Av.		13.1			25.9			39.7		
Prior Av. (m/min)		13.1			13.0			13.2		
Final Av. (m/min)					13.1					
Av. Super. Vel. (m/min)					31.4					
(cm/sec)					52.4					

Table 4.2 (Continued)

d_p (cm)	Scale on bed	Anaemometer Reading								
			Deviation			Deviation			Deviation	
		(m/min)	absolute	%	m/2min	absolute	%	m/3min	absolute	%
0.51	10	15.4	1.5		31.5	1.3		46.2	4.5	
	20	16.8	0.1	0.5	32.2	0.6		49.5	1.2	2.4
	30	15.8	1.1		29.7	3.1		46.7	4.0	
	40	17.1	0.2		33.2	0.4	1122	5825	1.8	
	50	18.9	2.0		37.0	4.2	12.8	55.8	5.1	10.1
	60	19.4	2.5	14.8	36.3	3.5		55.6	4.9	
	70	17.7	0.8		34.6	1.8		54.3	3.6	
	80	15.7	1.2		31.1	1.7		49.4	1.3	
	90	15.4	1.5		29.8	3.0		46.4	4.3	
Reading Av.		16.9			32.8			50.7		
Prior Av. (m/min)		16.9			16.4			16.9		
Final Av. (m/min)					16.7					
Av.Super. Vel.(m/min)					40.1					
(cm/sec)					66.8					

Table 4.2 (Continued)

d_p	Scale on bed	Annemometer Reading								
			Deviation			Deviation			Deviation	
(cm)		(m/min)	absolute	%	m/2min	absolute	%	m/3min	absolute	%
0.64	10	23.8	2.7		46.8	6.4		68.3	10.3	
	20	24.3	2.2		48.3	4.9		78.8	0.2	0.3
	30	23.7	2.8	10.6	47.4	5.8	10.9	75.3	3.3	
	40	28.5	2.0		57.1	3.9		89.0	10.4	
	50	28.9	2.4		58.9	5.7		90.4	11.8	15.0
	60	29.1	2.6		59.0	5.8	10.9	85.6	7.0	
	70	26.4	0.1	0.4	58.7	5.5		80.2	1.6	
	80	25.2	1.3		53.2	0.0	0.0	75.1	1.5	
	90	24.4	2.1		48.3	4.9		74.8	3.8	
Reading Av.		26.5			53.2			78.6		
Prior Av. (m/min)		26.5			26.6			78.6		
Final Av. (m/min)					26.4					
Av. Super. Vel. (m/min)					63.4					
(cm/sec)					105.7					

or the average and the farthest. For $d_p = 0.33$, the nearest to average deviates 0.0% and the farthest 12.9% which means the uniformity of the superficial air velocity for $d_p = 0.33$ cm. deviates at most 12.9%. Meanwhile for $d_p = 0.51$ and 0.64 cm the air velocity deviates at most 14.8% and 15.0% respectively. Hence the maximum deviation of the superficial air velocity in this experiment might not exceed 15.0% from average.

4.2 Determination of PFD Feed Rate (F), Voidage and Bulk Density

The measurement was described in 3.3.2. Table 4.3 showed all the measuring data. In details, feed rates for each speed are averaged from the amount of unagglomerate shown in table 4.6 to 4.11 The feed rate F_1 was averaged from table 4.6 to 4.8 and F_2 from table 4.9 to 4.11. For the first rate F_1, it is averaged 6.9 gm/min and the second rate F_2 = 10.8 gm/min.

4.3 Determination of Surface Tension.

The determined surface tension of PFD solution used in this experiment is observed from data relating the surface tension of PFD in gasoline of various PFD concentration as illustrated by fig 4.4 from which shows that higher concentration of PFD in gasoline increases the surface tension in a decreasing rate with an asymtote at the scale reading 16.5 on the meter. The scale reading on the surface tensiometer is then calibrated by relating the scale reading and the known values of surface tension as shown in table 4.5 and fig. 4.5. The scale reading of the asymtote presented the surface tension at 28 dyne/cm and this value would be used in this experiment. It should be remarked that the surface tension characteristic of polystyrene shown has a sharp deviation or bending point at the PFD weight = 900 mg/34 gm gasoline which corresponds to = 23 dyne/cm. Therefore, it is reasonable to anticipate that an individual sticky foam drop will attach to the other when its surface tension is at least 23 dyne/cm.

Table 4.3 PFD Characteristics and Feed Rate Determination.

Particle size (cm)	Weight of PFD 1500ml (gm)	Bulk Density (gm/ml)	Water filled (ml)	Voidage
0.33	16.55		583	
	18.40		617	
	18.20		605	
	15.85		599	
	17.10		603	
	18.50		608	
	17.65		595	
	16.45		605	
	19.00		591	
	16.65		603	
	17.44	0.0116	601.4	0.401

Table 4.3 (Continued)

Particle size (cm)	Weight of PFD 1500ml (gm)	Bulk Density (gm/ml)	Water filled (ml)	Voidage
0.51	20.50		576	
	18.75		588	
	18.15		591	
	16.65		586	
	17.75		563	
	19.35		587	
	17.40		564	
	18.35		562	
	18.10		570	
	19.50		582	
	18.45	0.0123	576.9	0.385

Table 4.3 (Continued)

Particle size (cm)	Weight of PFD 1500ml (gm)	Bulk Density (gm/ml)	Water filled (ml)	Voidage
0.64	19.80		566	
	21.45		569	
	17.35		581	
	17.55		576	
	18.70		570	
	17.95		578	
	16.55		580	
	20.30		5[illegible]4	
	17.25		567	
	18.80		584	
	18.57	0.0124	573.5	0.382

Table 4.4 Surface Tension Determination of Polystyrene Solution in gasoline.

Basis : Gasoline high octane 50 ml. = 34 gm

PFD added (mg)	Reading	Ratio (gmPFD/gm.gasoline)
0	13.1	0.000
800	15.3	0.024
1,800	15.5	0.053
2,800	15.7	0.082
3,800	15.8	0.112
4,800	15.8	0.141
5,300	15.6	0.156
6,300	16.3	0.185
7,300	16.5	0.215
7,800	16.5	0.229
9,000	17.5	0.265
10,500	17.4	0.309
11,500	18.1	0.338

Table 4.5 Surface Tensiometer Calibration

System	Tensiometer Reading	Actual Surface Tension dyne/cm.
1. Air Ethanol	14.4	22.6
2. Air CCl_4	16.7	26.8
3. Air Benzene	17.0	28.9
4. Air Water	21.1	71.9

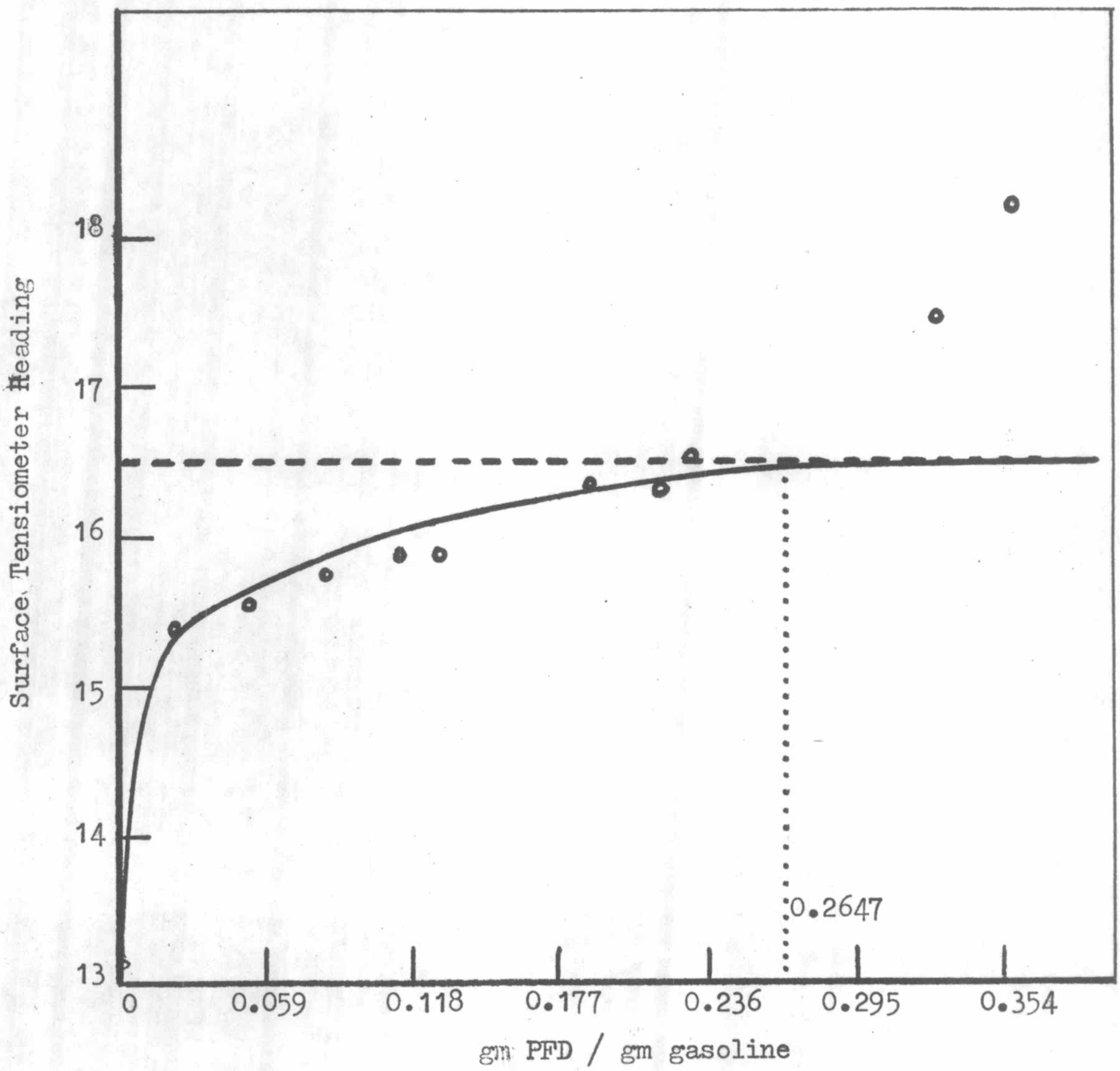

FIG. 4.4 SURFACE TENSION BEHAVIOUR OF POLYSTYRENE SOLUTION IN GASOLINE.

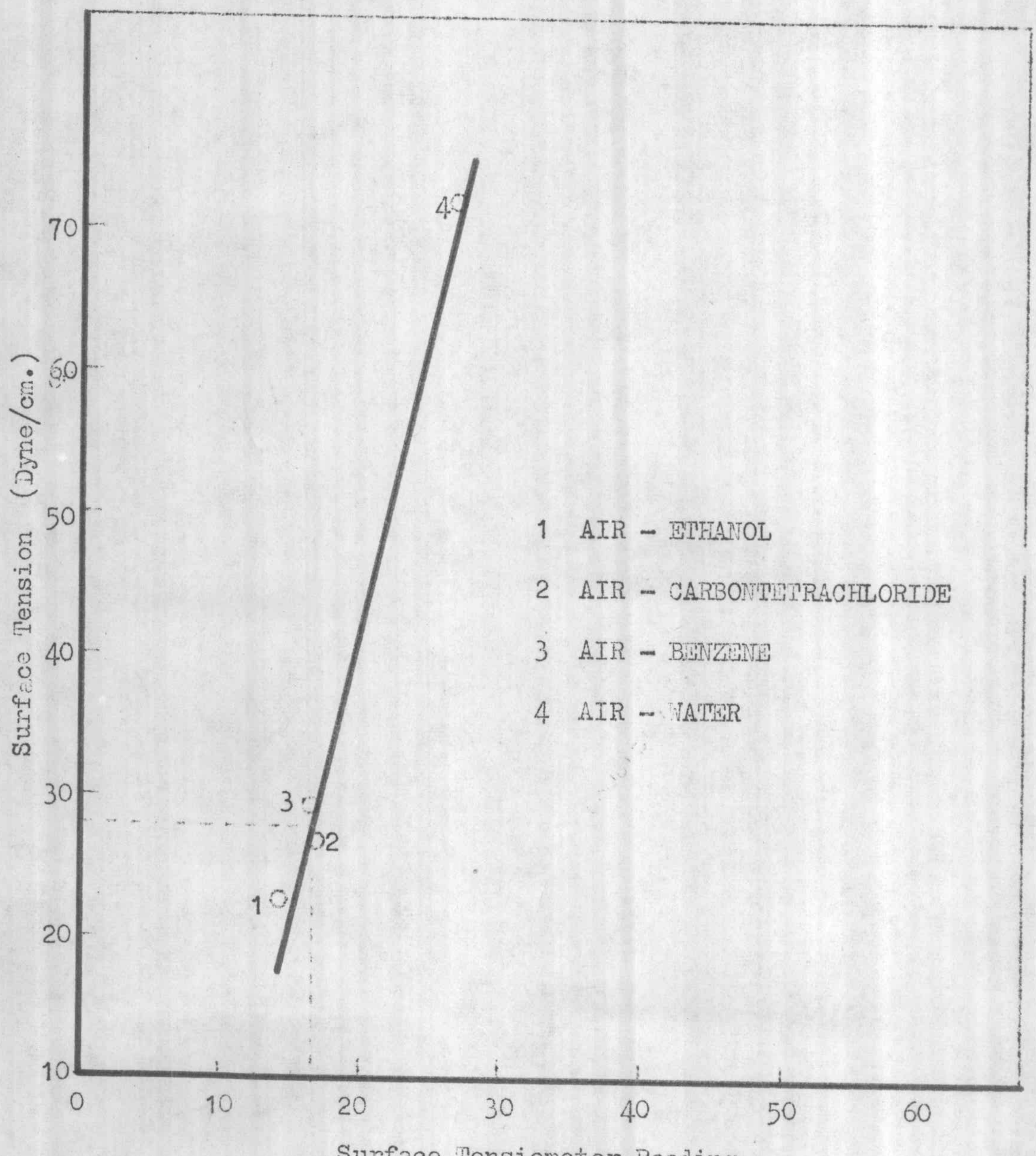

FIG. 4.5 SURFACE TENSIOMETER CALIBRATION

4.4 The Relationships of the Feed of Agglomerating Agent(C), the Number of Agglomerates(N), PFD Feed Rate(F) and PFD Sizes(d_p)

The experiments were conducted at the fixed two PFD feed rates so there should be two different feed rates of PFD for a group of different PFD sizes. For each PFD size, various amount of gasoline fed was sprayed through the inlet duct of the distributor. The number of agglomerates (N) occured during travelling along the bed length was counted as details shown in table 4.6 to 4.11 and the relationships between gasoline fed (C) and number of agglomerates occured (N) are presented in fig 4.6 to 4.11. The overall result is also shown in fig 4.12 which brought the curves from the forecoming fig 4.6 to 4.11 so that the effect of the two feed rate on different PFD size could be inspected. Fig 4.12 informed that the lower PFD feed rate (F) more agglomerates (N) was obtained. The slope and intersection of the straight line that related N versus C in fig 4.6 to fig 4.11 were evaluated by computer by means of Least Square Method, The result run by computer was shown in table 4.12 it showed two evaluations, the exponential and linear regression and by considering the sum of square error, the linear's is smaller and determined to satisfy the data.

Table 4.6 Effect of gasoline on number of agglomerates

PFD diameter = 3.3 m.m.

PFD feed rate = 7.8 gm/min

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
150	4	3					7	39	3500
160	5	8	2				15	39	3500
150	7	2					9	39	3500
150	5	1	2				8	39	3500
155	3	4	-	2			9	39	3500
165	7	1					8	39	3500
150	5	3	3	2			13	38	3400
150	8	1	1	2			12	38	3400
150	7	1	-	1			9	38	3400
150	5						5	39	3500
150	8	3	-	2	1		14	39	3500
160	3	6	3	1	1		14	40	3500
155	4	9	2				15	42	3600
160	17	2	-	-	1		20	39	3500
250	7	5	3				15	38	3400
245	10	10	-	4	-	1	25	38	3400
245	2	9	3				14	39	3500
245	8	5	3				16	40	3500
250	2	9	4	2			17	41	3500
250	6	4	3	5			18	39	3500
254	9	6	-	2			17	38	3400
260	8	5	-	3	2		18	40	3500

Table 4.6 (Continued)

Gasoline ml/5 min	Agglomerate							Unagglomerate	
	Number of drops in an agglomerate cluster						Total Cluster	Weight (gm)	Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
250	3	2	1				6	38	3400
260	2	5					7	39	3500
250	11	4					15	42	3600
250	9	3	4				16	42	3600
250	9	1					10	42	3600
250	5	3	7	2	-	1	19	42	3100
260	3						3	38	3400
245	10	2	-	2			14	39	3500
245	3	1	2				6	39	3500
245	4	8	2	4			18	39	3500
250	10	7					17	40	3500
420	8	6	3	2	3		22	40	3500
420	31	22	18	1			62	40	3500
420	12	4	8				24	42	3600
420	15	8	7	-	3		33	39	3400
420	11	5	5	7			28	38	3400
420	13	9	3	-	1		26	42	3600
425	14	9	21				44	42	3600
430	18	6	-	3			27	41	3500
430	17	10	1	4	3		35	43	3700
425	12	13	-	4			29	39	3400
420	9	7	3	1			20	38	3400
435	13	9	4				26	36	3300
435	9	7	-	2			18	38	3400
435	5	4	-	8			17	39	3500

Table 4.6 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster							Unagglomerate	
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Total Cluster	Weight (gm)	Volume (ml)
425	7	2					9	40	3600
425	11	3	6	5			25	41	3700
425	10	11	3	4			28	39	3500
525	29	17	5	-	1		42	39	3500
540	25	11	13	8	2	6	65	39	3500
540	16	12	4	8	1		31	45	3900
540	23	17	7	4			51	40	3600
530	-	-	-	-	-	-	∞	-	-
520	20	22	3	1			46	38	3400
520	12	7	5	-	-	2	26	42	3600
520	-	-	-	-	-	-	∞	-	-
520	18	5	3	2	-	1	29	40	3500
520	14	8	5	2	6		35	39	3400
620	27	24	18	-	-	3	72	38	3400
520	15	8	7	3			33	39	3500
520	- -	-	-	-	-	-	∞	-	-
520	8	6	4				18	41	3600
520	14	9	7	2	-	2	34	42	3600
530	-	-	-	-	-	-	∞	-	-
520	-	-	-	-	-	-	∞	-	-

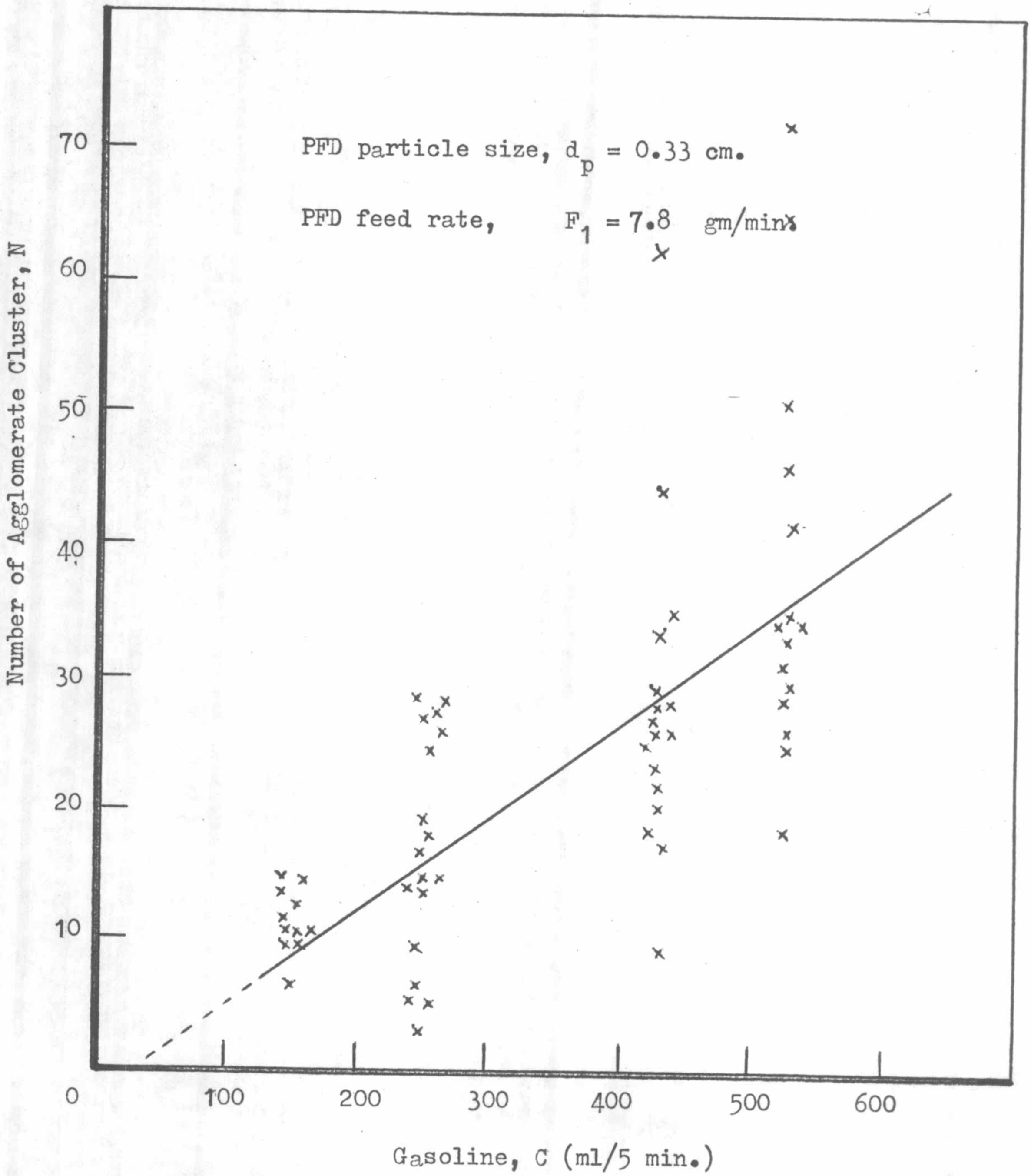

FIG. 4.6 EFFECT OF GASOLINE ON THE PFD AGGLOMERATION FOR d_p=0.33 cm. AT F_1

Table 4.7 Effect of gasoline on number of agglomerates

PFD diameter = 5.1 m.m.

PFD feed rate = 6.6 gm/min

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
150	7	4	1				12	30	3300
155	6	2					8	32	3400
140	7	-	2				9	31	3400
150	4	5					9	33	3500
150	3	3					6	32	3400
155	8	1					9	33	3500
155	6	3	1				10	35	3600
165	4	2	3				9	32	3400
165	7	1	2				10	30	3300
165	3	4					7	34	3600
165	5	3	4	2			14	33	3600
170	-	-	-	-	-	-	0	35	3700
155	3	5					8	32	3500
155	7	-	1				8	33	3600
155	5						5	30	3500
155	6	4					10	32	3400
155	7	4	1				12	34	3600
250	8	5					17	32	3500
250	7	8	2	2			19	30	3400
250	9	9	2				20	29	3300
250	5	6	-	2			13	32	3600
250	6	10	1	-			17	34	3700

Table 4.7 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster							Unagglomerate	
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Total Cluster	Weight (gm)	Volume (ml)
250	15	2	1	-	1		19	30	3300
250	6	3	-	1	2		12	33	3600
245	8	-	4	1			13	30	3400
255	4	5	1				10	34	3700
250	4	11	1				16	32	3600
255	3	1	-	1			5	33	3600
255	10	3	2				15	33	3600
255	13	17	-	2			32	34	3700
250	9	-	2				11	35	3700
250	7	4	-	1			12	32	3500
255	8	3	1	3			18	33	3600
255	11	9	3	-	1		24	34	3600
250	8	-	2	1			11	32	3500
420	5	3	1				9	34	3300
420	13	14	1	3			31	34	3300
420	8	4	3	1	2		18	34	3300
420	12	10	1	2	-	1	26	34	3300
435	7	3	8				18	34	3300
440	9	13	1	1			24	34	3300
435	7	8	3	2			20	34	3300
435	26	15	12	4	3	2	62	34	3300
435	8	6	2	1			17	34	3300
435	7	3	-	1	3		14	34	3300
420	9	5	-	2			16	34	3300
425	11	12	4				27	34	3300

Table 4.7 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	>20			
425	5	7	3	3			18	34	3300
420	10	7	2				19	34	3300
420	8	4	1	2			15	34	3300
420	6	6	3	1			16	34	3300
420	10	13	11	5	1	2	42	34	3300
420	14	5	-	1			20	34	3300
420	6	6	3	1	1		17	34	3300
525	- -	-	-	-	-	-	∞	-	-
525	8	9	4	-	2	1	24	34	3300
545	7	8	1	4	-	3	23	34	3300
540	10	5	3	4	1	1	24	35	3400
540	-	-	-	-	-	-	∞	-	-
525	11	5	3	4			23	35	3400
525	35	16	7	1	5	4	68	35	3400
540	6	5	4	-	5		20	34	3300
530	29	17	19	3	4		72	34	3300
530	20	13	4	2	1	2	42	34	3300
525	9	7	3	2			21	34	3300
530	-	-	-	-	-	-	∞	-	-
525	11	5	-	-	2	1	19	34	3300
540	8	6	4	-	3		22	35	3400
545	-	-	-	-	-	-	∞	-	-
525	8	5	4	3	1	1	22	34	3300
525	6	3	6	1	2	2	20	34	3300

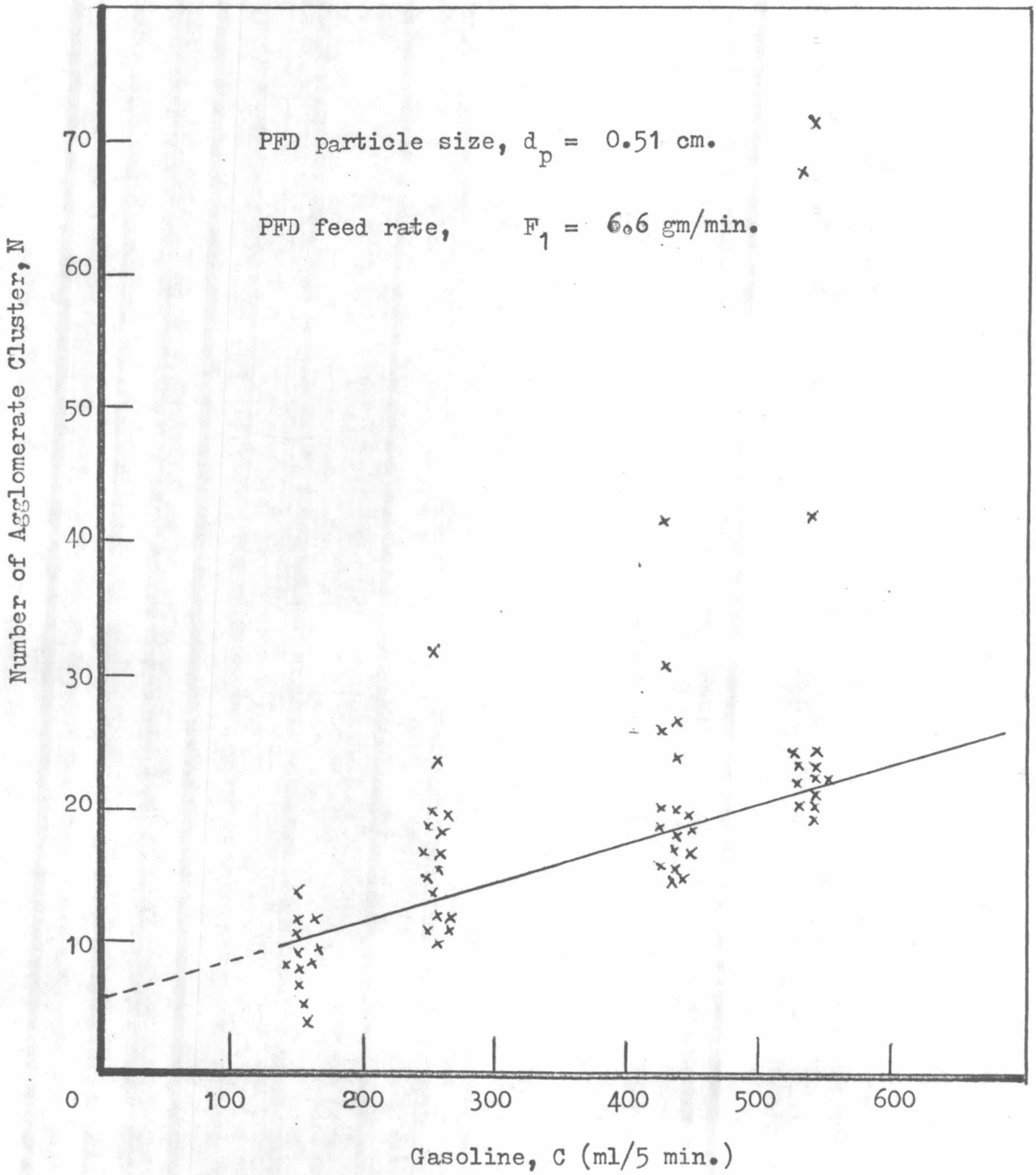

FIG. 4.7 EFFECT OF GASOLINE ON THE PFD AGGLOMERATION FOR d_p=0.51 cm. AT F_1

Table 4.8 Effect of gasoline on number of agglomerates

PFD diameter = 6.4 m.m.

PFD feed rate = 6.3 gm/min

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
150	-	-	-	--	-	-	0	33	3500
160	-	-	-	-	-	-	0	30	3300
160	4	2	-	-	-	-	6	32	3400
160	-	-	-	-	-	-	0	32	3400
160	3						3	33	3500
160	-	-	-	-	-	-	0	34	3600
160	2						2	33	3600
160	5						5	33	3500
150	-	-	-	-	-	-	0	32	3500
150	3						3	34	3600
160	3						3	33	3500
150	-	-	-	-	-	-	0	34	3600
255	8	6	4	-	1		19	33	3500
265	3	3	2				7	32	3400
255	6	3	4	2	2		18	34	3600
265	9	3	1				13	30	3200
265	4	3	2				9	32	3400
255	7	4	3	-	1		15	32	3400
255	5	1	-	1			7	35	3700
255	7	4	-	2			13	34	3600
255	4						4	33	3500
255	5	3	2				10	33	3500
265	4	-	2				6	32	3400

Table 4.8 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3–4)	(5–6)	(7–9)	(10–20)	>20			
255	2						2	33	3500
255	6	1	-	1	1		9	34	3600
255	3	4	-	1			8	32	3400
270	3	3					6	34	3600
270	2						2	33	3500
265	4	3	1				8	32	3400
255	5	2					7	32	3400
420	7	4	1				12	30	3300
425	6	6	-	3	3		18	30	3300
420	5	7	3				15	30	3300
420	8	3	1	1			13	30	3300
420	4	5					9	30	3400
435	6	3	1				10	30	3400
435	4	5	-	1			10	30	3300
440	3	2					5	30	3300
435	9	3	2				14	32	3400
435	6	7					13	32	3400
420	4	11	1				16	32	3400
420	8	2	1				11	32	3400
425	7	4	1				12	30	3300
435	9	7	3	2			21	30	3300
425	10	1					11	30	3300
420	5	6	2				13	30	3300
420	8	4	2	2			19	30	3300
420	5	2					7	32	3400

Table 4.8 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	>20			
510	7	6	1				14	30	3400
510	6	9	-	1			16	30	3400
515	7	3					10	30	3400
515	4	8	3				15	30	3400
525	8	10	2	2			22	32	3600
525	8	6	1				15	32	3600
525	9	-	3				12	30	3400
525	4	5					9	30	3400
525	5	4	4				13	30	3400
530	5	2	-	1			8	30	3300
540	6	5	2				13	30	3300
540	3	2					5	30	3300
540	2	4					6	32	3600
540	10	3	1	2			16	31	3500
540	9	5	-	1			15	30	3400
515	7	4	1				12	30	3400
515	5	8	1				14	31	3500
515	11	5	2	3			20	30	3400
515	12	3	-	1			16	30	3400
630	6	7	-	1			14	32	3600
630	5	3	1				9	32	3600
630	7	4	2				13	32	3600
635	4	5	8				17	32	3600
640	-	-	-	-	-		∞	-	-

Table 4.8 (Continued)

Gasoline ml/5 min	Agglomerate							Unagglomerate	
	Number of drops in an agglomerate cluster						Total Cluster	Weight (gm)	Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	>20			
630	-	-	-	-	-	-	∞	-	-
600	-	-	-	-	-	-	∞	-	-
630	8	5	-	-	1	2	16	30	3400
630	-	-	-	-	-	-	∞	-	-
630	11	4					15	31	3500
630	7	6	1	-	-	1	15	30	3500
635	3	5	3	1			12	31	3500
630	8	5	3	4			20	31	3500
672	-	-	-	-	-	-	∞	-	-
630	-	-	-	-	-	-	∞	-	-
630	15	13	9	3	2		42	30	3300
630	21	17	8	5			51	30	3300
630	4	7	4				15	30	3300
630	19	23	12	7	1	3	65	30	3300
650	-	-	-	-	-	-	∞	-	-

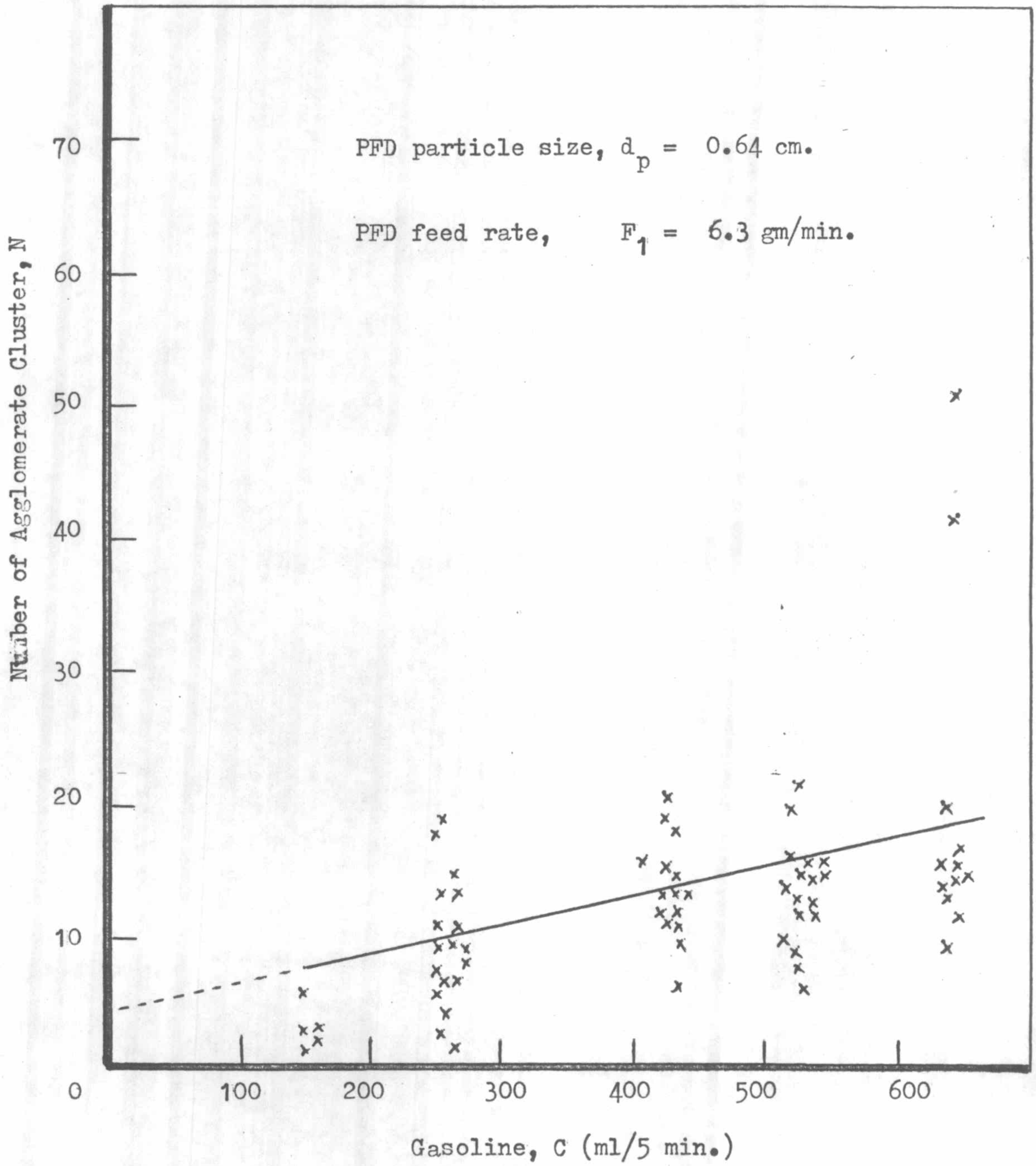

FIG. 4.8 EFFECT OF GASOLINE ON THE PFD AGGLOMERATION FOR d_p =0.64 cm. AT F_1

Table 4.9 Effect of gasoline on number of agglomerates

PFD diameter = 3.3 m.m.

PFD feed rate = 11.3 gm/min

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
150	2	4	2				10	60	5100
150	-	4	3				7	60	5100
155	-	-	5	2			7	60	5100
165	-	-	-	-	-	-	0	60	5100
150	-	-	1				1	62	5400
150	-	2					2	64	5500
150	1	-	4	1			6	64	5500
155	1	2	4				7	62	5400
165	-	-	5	1			6	60	5100
140	-	4	1				5	57	4900
155	3	1 2	2	1			7	57	4900
150	2	5	1	2			10	64	5500
150	6	2	-	1			9	56	4800
150	-	3	1				4	62	5400
150	4	6	1				11	57	4900
150	1	3	2				6	54	4700
254	1	-	4	1			6	60	5100
255	2	4	5	1	2		15	57	4900
260	-	4	2	4			10	54	4700
255	-	2	3	5			10	61	5300
260	3	1	4				8	57	4900
254	-	4	2	6			12	63	5400

Table 4.9 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster							Unagglomerate	
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Total Cluster	Weight (gm)	Volume (ml)
260	7	4	1				12	62	5300
260	5	3	-	1			9	60	5100
260	2	4	3				9	61	5300
270	-	4	1	1			6	62	5300
270	3	4	1	2	-	1	11	57	4900
260	4	4	-	1			9	60	5100
254	8	4	1	2			15	60	5100
260	1	3	2	1			7	62	5300
260	6	6	1				13	61	5300
270	3	4	2	-	1		10	57	4900
260	5	3	1	2			11	57	4900
254	8	3	2				13	57	4900
270	3	2	4				9	57	5100
260	6	5	1				12	54	4700
420	7	4	1	3	1		16	54	4900
420	4	5	1	2			12	54	4800
433	3	4	2	1			10	57	5100
420	4	5	1	1	-	1	12	54	4900
418	6	3	4	2			15	57	5200
425	-	7	4	1	1		13	54	4800
420	8	3	2				16	54	4900
420	15	4	1	3	1	1	20	55	5000
420	6	8	3	1			18	54	4900
420	9	6	2	3	2		22	54	4900
420	8	5	3	-	2	1	19	54	4900

Table 4.9 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volum (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	>20			
425	12	1	5	4			23	56	5000
433	9	4	2	3	1		19	57	5100
418	8	4	6	3			21	57	5100
42o	15	3	6	1	2	1	28	54	4900
420	8	3	4	1	1	1	18	52	4600
425	4	8	4	2	1		19	54	4900
420	11	7	1	3	-	1	23	54	4800
420	7	5	3	1			16	54	4900
420	8	6	1	2			17	57	5100
420	6	6	3	2	1		18	57	5100
523	16	2	4				22	55	4800
520	9	6	-	2			17	57	5100
530	11	5	5				20	56	4900
520	18	5	2	1			26	56	4900
515	14	8	1	1			24	56	4900
520	7	11	2	6	-	2	28	57	5100
520	19	8	2	1	1		31	57	5100
520	14	8	-	2	1	1	26	57	5100
515	7	5	1	3	1		17	54	4800
530	10	8	4	1			28	57	5100
515	8	7	2	4			21	54	4900
520	8	12	2	1	-	1	24	54	4900
520	17	-	2	1			20	54	4900
520	10	4	6	5	2	1	28	54	4900
520	16	2	3	1	2		24	54	4900

Table 4.9 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster							Unagglomerate	
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Total Cluster	Weight (gm)	Volume (ml)
520	7	8	4	8	1		28	57	5100
520	11	6	3	2	-	1	23	57	5100
520	8	9	8	5			30	55	4900
628	8	6	8	4			26	53	4800
630	35	18	6	5	2	2	68	57	5100
605	9	9	7	6	1		32	53	4900
610	12	7	8	2	1		30	53	4800
630	8	19	9	7	-	2	45	52	4600
630	-	-	-	-	-	-	∞	-	-
650	25	17	-	8	3	1	54	52	4600
630	19	5	-	3	4	2	32	54	4900
630	17	13	6	5	3	2	46	54	4900
630	8	11	8	-	4	1	32	54	4900
630	6	5	9	8	-	2	30	55	4900
650	8	12	6	7			33	54	4900
630	-	-	-	-	-	-	∞	-	-
620	-	-	-	-	-	-	∞	-	-
630	27	32	10	1	4	8	82	53	4800
630	-	-	-	-	-	-	∞	-	-
630	11	6	8	4	2	1	32	54	4900
630	7	12	5	3	1		28	54	4900
635	-	-	-	-	-	-	∞	-	-

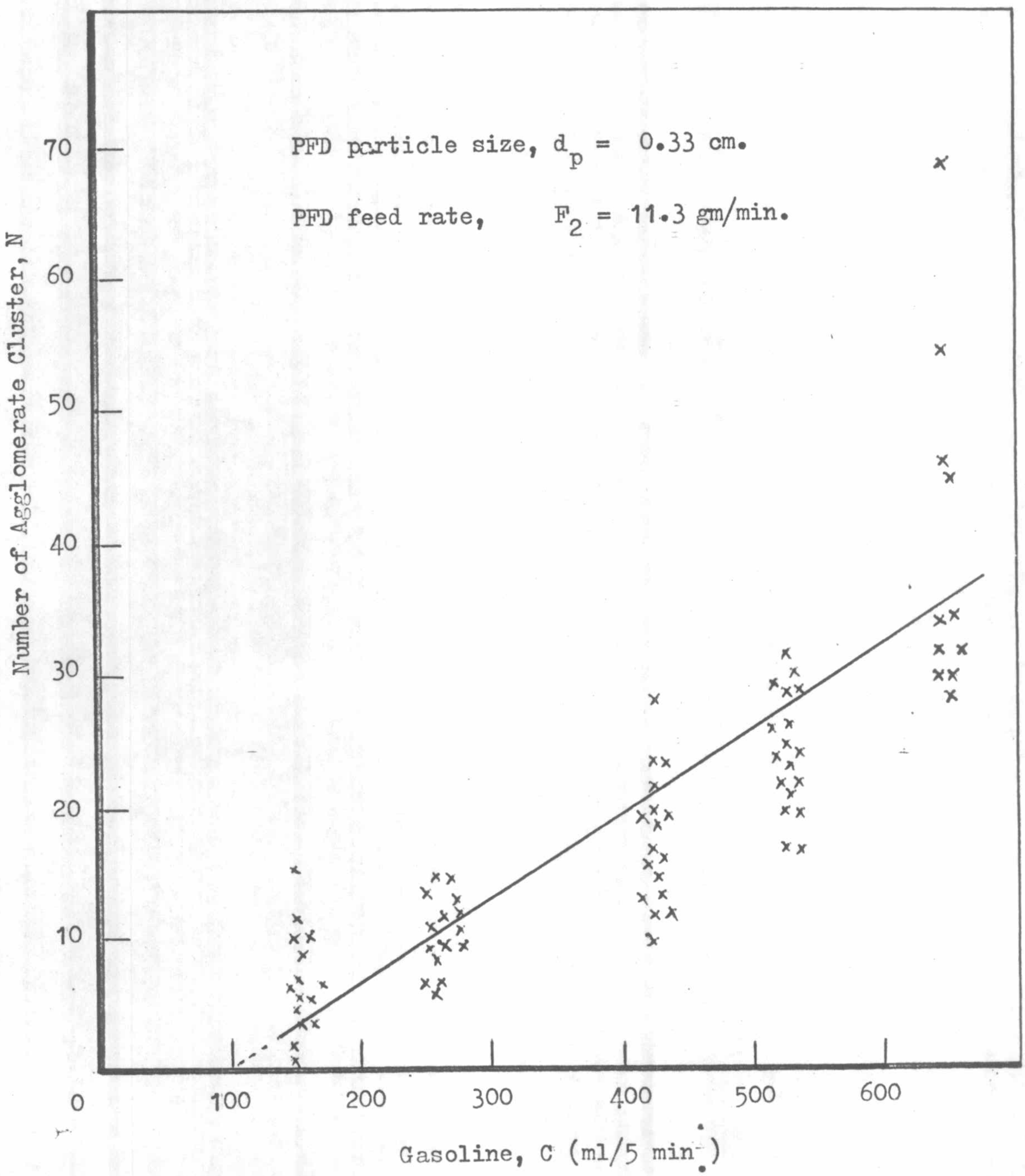

FIG. 4.9 EFFECT OF GASOLINE ON THE PFD AGGLOMERATION FOR d_p=0.33 cm. AT F_2

Table 4.10 Effect of gasoline on number of agglomerates

PFD diameter = 5.1 m.m

PFD feed rate = 10.7 gm min

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster: 2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Total Cluster	Unagglomerate: Weight (gm)	Volume (ml)
150	2	2					4	55	5500
155	–	2					2	55	5500
140	–						0	55	5500
150	4	2	1				7	54	5400
150	3	5	1	1			10	54	5400
140	3	3					6	54	5400
165	2	4					6	53	5300
150	5	2					7	53	5300
150	5						5	54	5500
150	4	1					5	53	5300
150	2	3					4	51	5100
140	6	1	1				8	52	5200
140	3	1	2				6	55	5500
150	3						3	54	5400
165	6	1	1	1	1		9	53	5300
150	–						0	55	5400
150	3						3	54	5400
260	3	2	1				6	55	5500
255	5	2					7	54	5400
255	5	3	1				9	53	5300
260	3	4	1				8	52	5200
260	2	3	2				7	52	5200

Table 4.10 (Continued)

Gasoline ml/5 min	Agglomerates: Number of drops in an agglomerate cluster						Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
260	4	1	2				7	54	5400
255	1	4	–	1			6	54	5400
270	2	1					3	54	5400
260	4	6	3	1	1		15	55	5400
260	7	1	1				9	52	5200
255	5						5	52	5200
255	2	4	2	2			10	54	5400
260	1	2	1				4	54	5400
260	3	4	1				8	53	5300
260	5						5	54	5600
255	3	2	1				6	58	5700
260	4	2	2				8	54	5400
420	4	2	3				9	54	5300
420	8	2					10	53	5300
430	3	3	1	2			9	53	5300
440	4	7					10	53	5300
420	5	2	1				8	53	5300
420	10	3	4	1			18	53	5300
440	7	2					9	52	5100
420	6	–	–	5	–	1	12	52	5200
420	3	6	–	1	1		11	51	5100
420	4	1	1				6	53	5300
420	3	2	2				7	51	5100

Table 4.10 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
440	6	2					8	51	5100
440	8	-	3	1			12	53	5300
410	-	3	-	2	5	1	11	53	5300
420	4	3	1				8	53	5300
440	2	7	-	1			10	54	5400
420	8	5	2	1	1		17	55	5500
520	4	7	8	-	-	-	19	52	5100
520	6	14	-	1			21	53	5300
520	8	6	3	-	2		19	53	5300
520	7	2	7				16	53	5300
450	11	2	2	1	1		17	54	5400
450	8	5	1	-	1		15	51	5100
450	6	3	-	1			10	53	5400
520	7	7	-	2	1		18	54	5400
520	3	5	3	3			14	53	5300
520	9	2	-	2			14	53	5300
520	9	3	2	1	1	1	17	53	5300
570	11	2					13	52	5200
520	8	6	1				15	51	5100
520	7	5	3	1			16	51	5200
520	13	8	3	-	-	1	25	51	5200
520	6	4	3	5			18	50	5100
520	8	2	1	-	-	1	17	50	5100
450	5	11	4				20	53	5300
450	5	7	7				19	51	5100

Table 4.10 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster							Unagglomerate	
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Total Cluster	Weight (gm)	Volume (ml)
630	-	-	-	-	-	-	∞	-	-
630	7	4	3	2			16	53	5300
605	11	2	3	3			19	52	5100
605	-	-	-	-	-	-	∞	-	-
640	31	9	3	-	-	2	45	52	5300
640	7	5	4	3	1		20	52	5100
640	3	8	5	1			17	54	5500
630	9	3					12	51	5100
630	4	7	3	-	1		15	53	5300
630	6	3	1	-	3	1	14	53	5300
605	-	-	-	-	-	-	∞	-	-
605	9	3	1	-	5	1	18	60	5400
605	4	2	3	-	1		10	53	5300
630	8	7	-	5			20	55	5500
630	6	3	4	1	3		17	53	5300
630	-	-	-	-	-	-	∞	-	-
605	6	7	2	-	4	2	25	55	5600
630	21	11	8	18	6	3	67	54	5600
640	8	5	2	3	1		19	55	5600
630	9	7	3	-	-	1	20	53	5300
640	18	8	4	2	1		33	53	5300

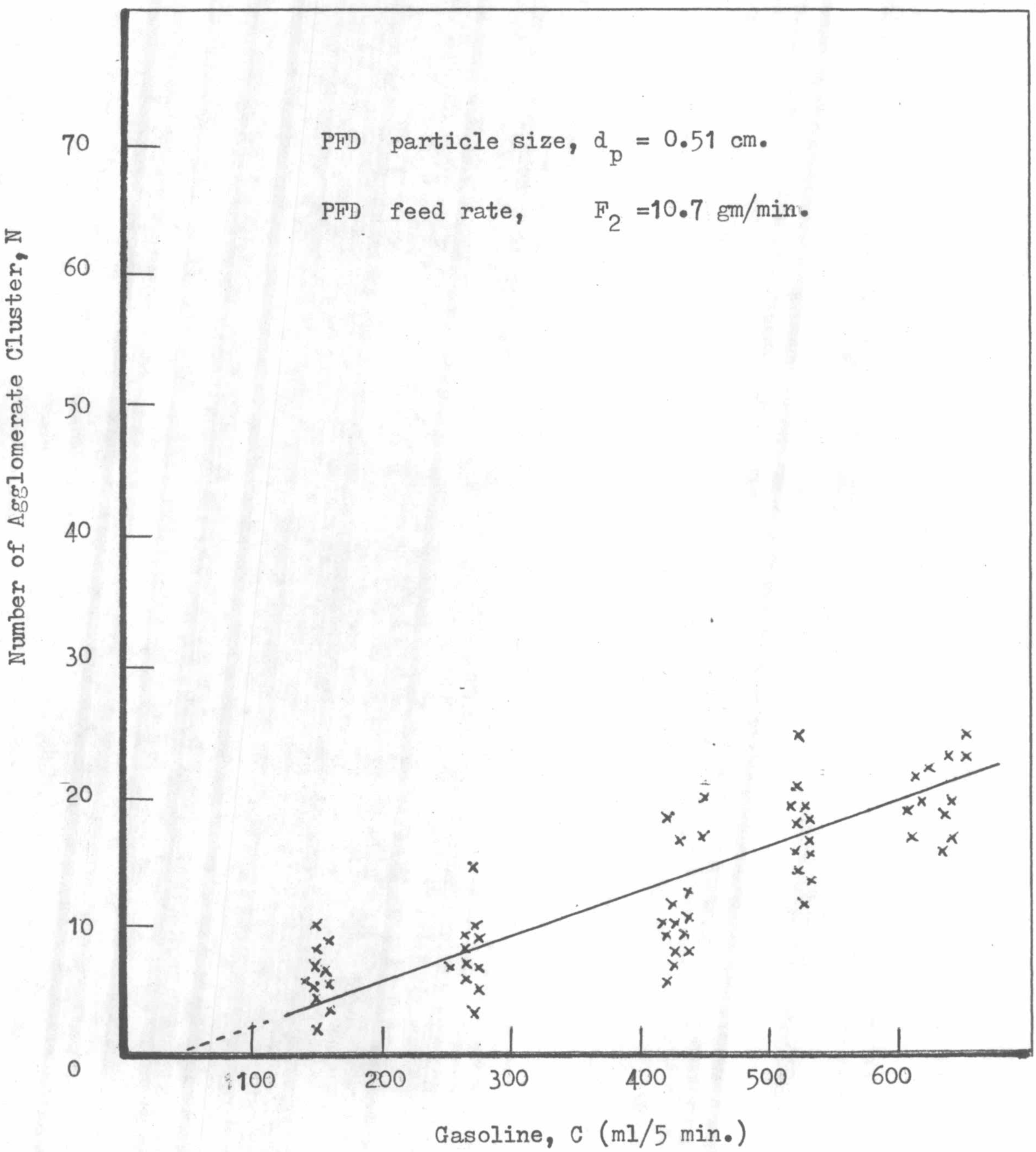

FIG. 4.10 EFFECT OF GASOLINE ON THE PFD AGGLOMERATION FOR d_p=0.51 cm.AT F_2

Table 4.11 Effect of gasoline on number of agglomerates

PFD diameter = 6.4 mm.

PFD feed rate= 10.5 gm/min.

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3–4)	(5–6)	(7–9)	(10–20)	> 20			
150	–	–	–	–	–	–	0	52	5300
150	–	–	–	–	–	–	0	52	5300
160	1	2					3	52	5400
165	–	–	–	–	–	–	0	52	5400
150	2						2	52	5400
150	–	–	–	–	–	–	0	54	5500
150	–	–	–	–	–	–	0	54	5500
155	–	–	–	–	–	–	0	54	5500
150	–	–	–	–	–	–	0	54	5500
150	–	–	–	–	–	–	0	52	5400
255	5	2					7	52	5400
255	–	–	–	–	–	–	0	54	5400
255	2						2	52	5400
255	4	1					5	53	5400
255	4						4	52	5400
265	1	2					3	52	5400
265	5	1					6	52	5400
265	2	5	3				12	52	5400
265	1	3					4	54	5500
270	6	2	1				9	52	5300
255	4	2					6	52	5400
255	3	2					5	52	5400

Table 4.11 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
255	3	2					5	52	5400
255	1	2	1				4	52	5400
265	–						0	52	5400
270	3						3	52	5400
265	5	2	–	1			8	52	5400
255	–						0	52	5400
270	–						0	52	5400
265	–						0	52	5400
255	–						0	52	5400
255	–						0	52	5400
420	5	3					8	52	5400
425	7	6	–	1			14	52	5400
420	5	1					6	52	5400
420	4	3	–	2			9	55	5600
420	2						2	52	5300
420	5	2	1				8	52	5500
420	3	4	1	1			9	52	5400
420	4	6	1	–	1		12	52	5400
425	3	5	–	2	1		11	52	5400
425	6	1					7	52	5400
435	3	2	–	2			7	52	5400
420	4	3	1				8	52	5400
425	8	2					10	52	5400

Table 4.11 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3–4)	(5–6)	(7–9)	(10–20)	> 20			
425	5						5	52	5400
420	4	8					12	55	5600
420	6						6	53	5500
420	5						5	54	5600
420	6	–	1				7	52	5400
420	4	5	3	1			13	52	5400
525	5	2					7	53	5400
525	3	4	1	1			9	54	5400
508	2						2	58	5700
508	8	1	–	1			10	52	5300
525	6	5	3				14	52	5400
525	3						3	52	5300
540	9	5	3	–	4		21	52	5300
508	7	8	1	2			18	52	5300
530	6	6					12	52	5300
525	8						8	52	5300
525	4	5	–	1			10	52	5300
525	3	7	1				11	52	5300
525	8	3					11	52	5400
525	5	6	2				13	52	5400
525	4	7	1				12	52	5400
525	8	4	3	2			17	52	5300
525	3	6	–	–	1		10	55	5600

Table 4.11 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total	Ungglomerate: Weight (gm)	Ungglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20	Cluster		
540	7	–	2				9	53	5400
525	5						5	52	5300
525	7	2	3	3	–	1	16	52	5300
628	2						2	52	5300
600	–						∞	–	–
615	4	5	2				11	53	5500
600	–	–					∞	–	–
630	6	4	2	–	2		14	52	5300
600	7	3	–	1	1	1	13	52	5300
630	5	5	1	1			12	52	5300
635	7	3					10	54	5500
642	8	4	–	2			14	53	5500
630	6	1	2				9	52	5300
640	18	6	–	1			25	52	5300
630	6						6	52	5300
630	21	27	12	3	2		65	52	5300
630	5	–	3				8	52	5300
630	12	3	4				19	53	5400
630	6	5					12	52	5400
630	3						3	52	5400
630	7	–	1	2			10	52	5300
642	11	2					13	52	5300
718	5	3	–	2			10	52	5300

Table 4.11 (Continued)

Gasoline ml/5 min	Agglomerate: Number of drops in an agglomerate cluster						Agglomerate: Total Cluster	Unagglomerate: Weight (gm)	Unagglomerate: Volume (ml)
	2	(3-4)	(5-6)	(7-9)	(10-20)	> 20			
720	–						∞	–	–
732	23	19	18	–	2	3	65	52	5300
735	5	5	5	3			18	52	5300
760	14	8					22	52	5300
718	–						∞	–	–
777	–						∞	–	–
730	–						∞	–	–
730	7	6	5				18	52	5300
748	29	22	13	4	1	1	70	58	5800
730	31	12	6	3			52	52	5300
730	–						∞	–	–
740	8	3					11	52	5300
730	9	3	5	–	1	1	20	52	5300
724	14	2	–	3			10	52	5300
755	8	–	3				11	54	5400
730	19	18	2	2			41	53	5300
718	18	5	1				24	52	5300
740	6	6	3				15	52	4500
730	–						∞	–	–

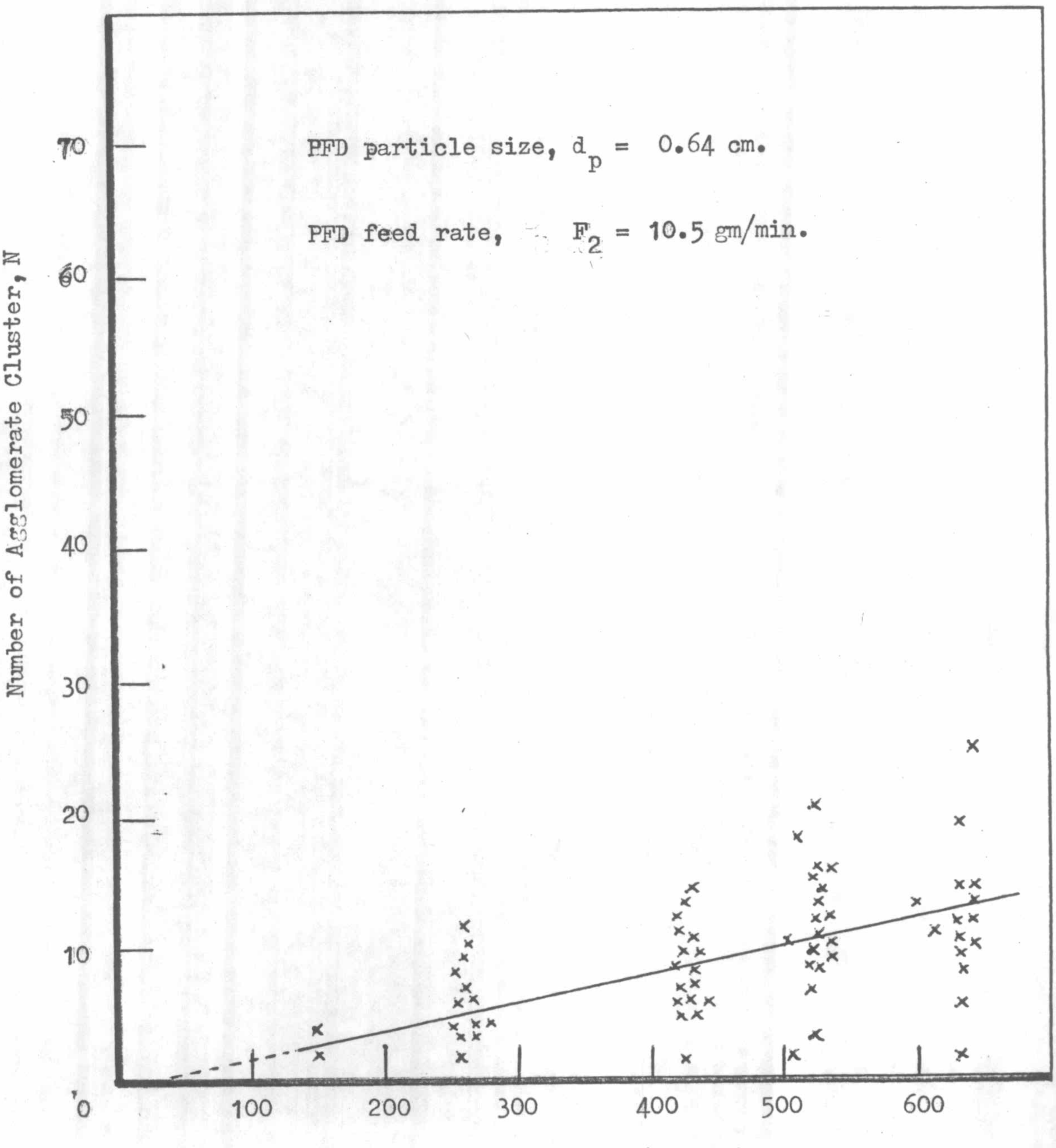

FIG. 4.11 EFFECT OF GASOLINE ON THE PFD AGGLOMERATION FOR d_p=0.64 cm. AT F_2

Table 4.12 Least Square Method determines the curves related between number of agglomerates and gasoline amount

x = gasoline amount

y = number of agglomerates

Data from Table	Exponential Evaluation $y = ax^b$		
	a	b	Sum Square of Error
4.6	.0902792	.9992660	6988.8870000
4.7	.1359477	.8975495	7676.5100000
4.8	.0936514	.8562108	9152.8460000
4.9	.0158632	1.2568840	5767.8240000
4.10	.0548151	.9593638	4306.5690000
4.11	.0031731	1.3953610	18032.4300000

Data from Table	Linear Evaluation $y = a+bx$		
	a	b	Sum Square of Error
4.6	-2.1759240	.1082384	6527.1840000
4.7	5.0715720	.0464540	20016.9500000
4.8	4.1822870	.0343760	8746.6670000
4.9	-6.3432640	.(967683	5657.8770000
4.10	-1.5557520	.0533321	4058.5350000
4.11	-.5595392	.0315607	8808.5250000

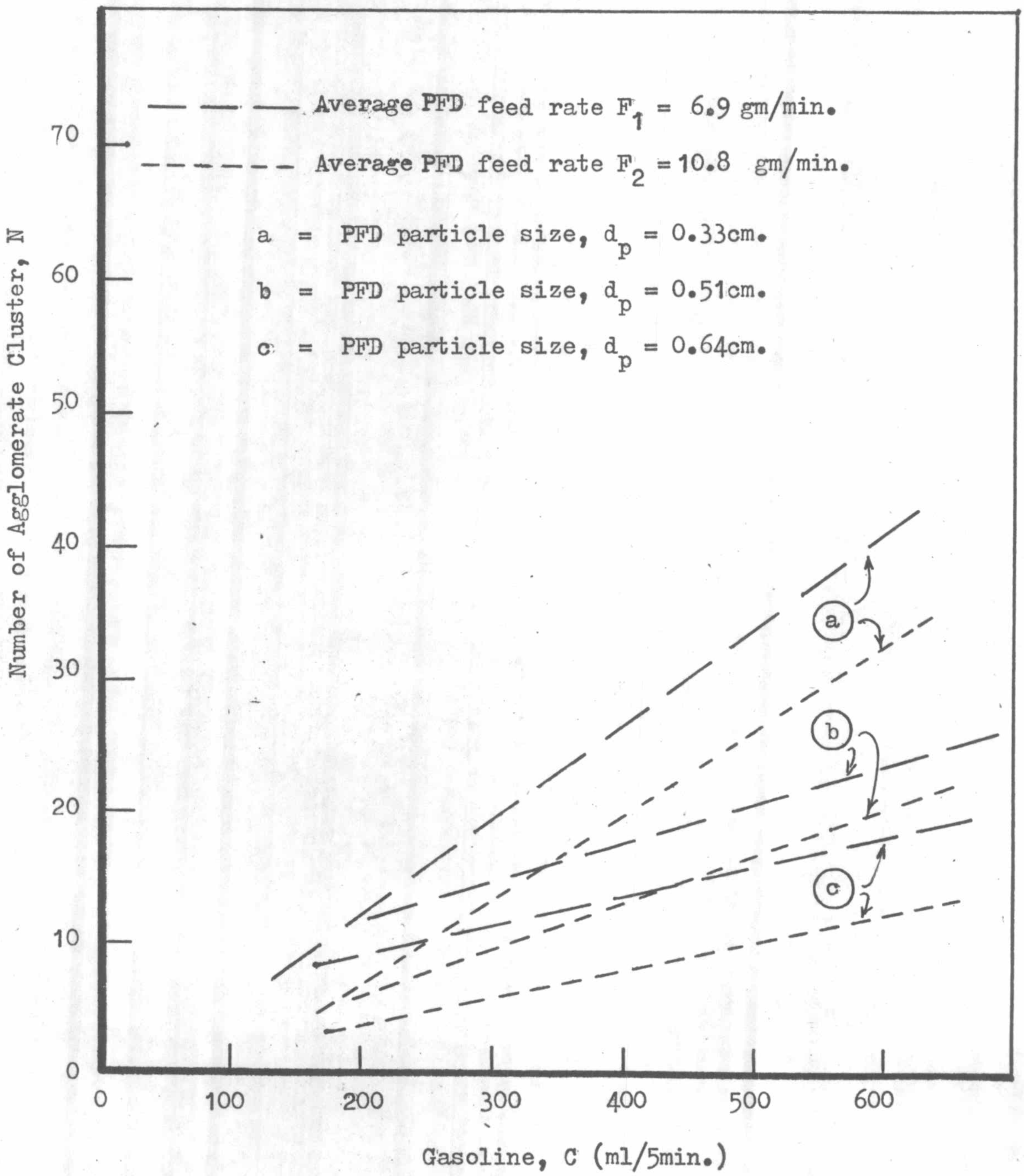

FIG. 4.12 EFFECT OF GASOLINE ON THE AGGLOMERATION OF PFD DIFFERENT SIZE AND FEED RATE