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Problems in flotation

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PROBLEMS IN FLOTATION.

BY

William Henry McCartney.

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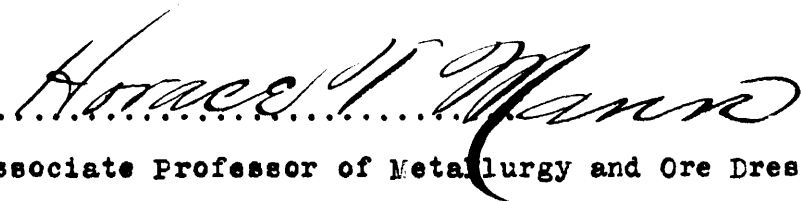
THESIS

submitted to the faculty of the
SCHOOL OF MINES AND METALLURGY OF THE UNIVERSITY OF MISSOURI
in partial fulfillment of the work required for the
Degree of
BACHELOR OF SCIENCE IN MINE ENGINEERING

Rolla, Mo.

1916.

Approved by.....



Associate Professor of Metallurgy and Ore Dressing.

19506

Index.

1. Title
2. Object.
3. Introduction.
4. Apparatus.
5. Data, Curves, Figures, etc.
6. Conclusions.

Little has been done to classify oils on the basis of their action as flotation agents, either for their frothing or their selective qualities. The only available information at the present time is an article by C. Y. Clayton and C. E. Peterson in the Mining and Scientific Press of April 22, 1916.

This investigation was undertaken chiefly to aid in effecting such a classification.

Flotation of mineral on the surface of water by means of the frothing process is a problem which is receiving much attention at the present time. Portions of the ore which, after mill treatment in former times were lost, can be and are today retreated by flotation at small cost, and the percentage of extraction of the mill greatly increased. Many mills have increased their percentage extraction from the customary 70 % to 85 % and in some few cases to 92 % of the valuable mineral.

A development of the Hoover type of Minerals Separation testing-machine was used, with an air-lift to complete the circulation of the pulp from the bottom of the spitzkasten to the upper portion of the agitator cell. A half-horsepower motor was used to drive the impeller at a constant speed of 2100 revolutions per minute.

Skimming of the float was affected by means of a flat, round, perforated spoon-skimmer.

The tails were sampled by a glass tube with a wire through it attached to a rubber stopper attached at the lower end. (See diagram). This was placed in the pulp with the bottom end closed. It was then opened and closed again, and when filled was withdrawn.

All the concentrate and the sample of the tails were then placed in pans and dried on a gas hot-plate, weights recorded, and analysed for their zinc content.

All factors of operation remained constant except the kind of oil.

Each charge was as follows:

Water.....	3200 gm.
Ore.....	400 grm.
Oil.....	4 drops.
Time of run.....	15 minutes
Speed of impeller.....	2100 R. P. M.

The ore showed by checked analysis 1.75 % Zinc.
It is from a sludge pond in the Joplin District.

Vogay Ore.

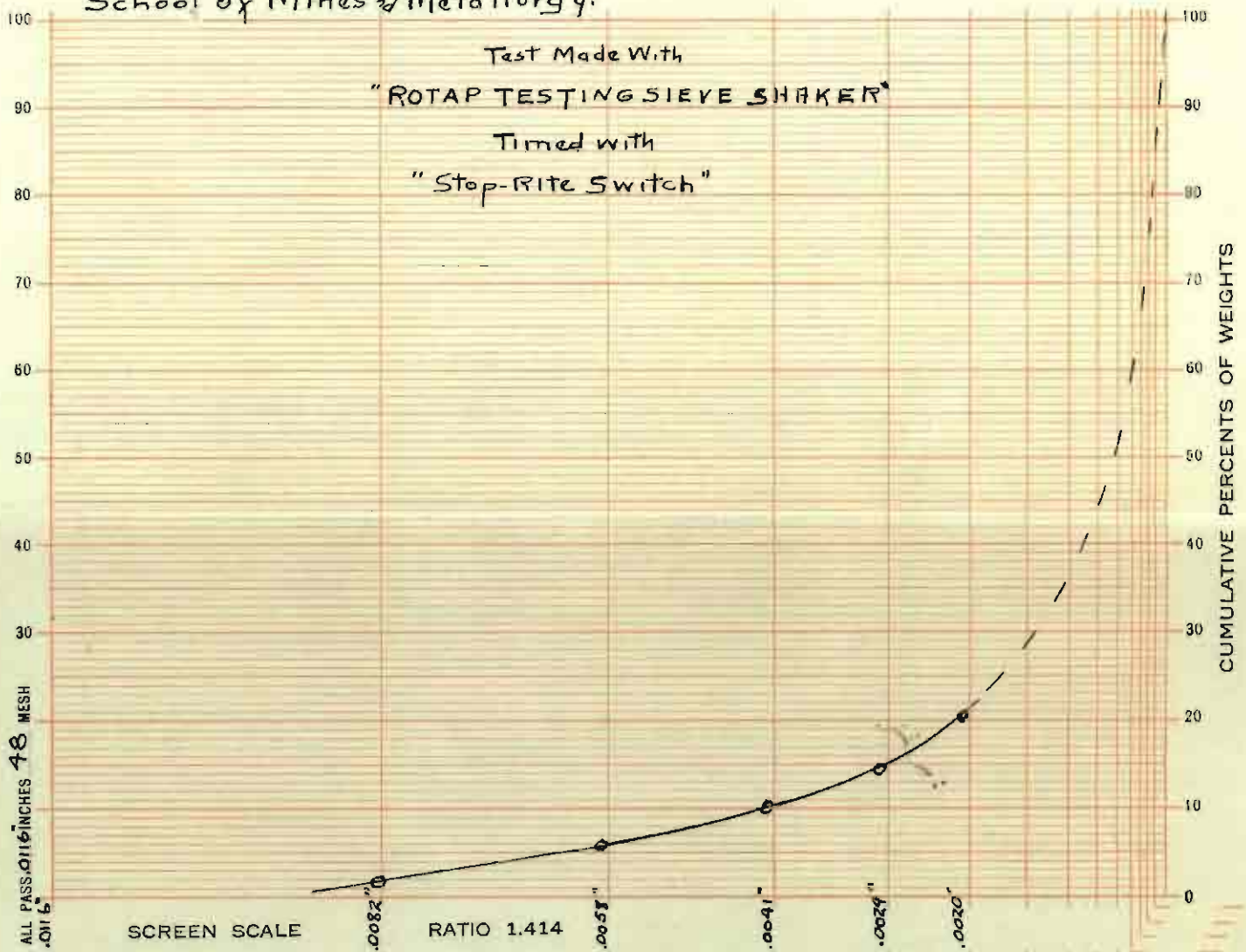
The Tyler Standard Screen Scale

Cumulative Direct Diagram of Screen Analysis on Sample of Material #297

Name University of Missouri

Date May 6, 1916

School of Mines & Metallurgy.



Indicate the Screen Crushed through and also First Retaining Screen	SCREEN SCALE RATIO 1.414				WEIGHTS			ASSAYS	CONTENTS	% of Total Contents
	Openings		Mesh	Diameter Wire Inches	Sample Weights	Per Cent	Per Cent Cumulative Weights			
Inches	Milli-meters									
	1.050	26.67		.149						
	.742	18.85		.135						
	.526	13.33		.105						
	.371	9.423		.092						
	.263	6.680	3	.070						
	.185	4.699	4	.055						
	.131	3.327	6	.036						
	.093	2.362	8	.032						
	.065	1.651	10	.035						
	.046	1.168	14	.025						
	.0328	.833	20	.0172						
	.0232	.589	28	.0125						
	.0164	.417	35	.0122						
	.0116	.295	48	.0092						
All Pass Ret'd On	.0082	.209	65	.0072	1.0	1.3	1.3			
"	.0058	.147	100	.0042	3.0	4.0	5.3			
"	.0041	.104	150	.0026	3.0	4.0	9.3			
"	.0029	.074	200	.0021	3.5	4.7	14.0			
Pass	.0029	.074	200	.0021	4.5	6.0	20.0			
			Total		75.0	100.0				

SIEVED 20 MIN with shot.

Machine Flower Type
 Experimenter McCartney
 ORE 1.75 % Zn-
Joplin Sludge.
400gm to charge.

Missouri School of Mines and Metallurgy
FLOTATION LABORATORY.

OPERATING DATA.

H ₂ O	3200	gm
Oil	4 Drops	
Rpm	2100	

Thesis - Problems in Flotation

Test No.	OIL			REAGENTS		FROTH		REMARKS.	RESULTS					
	No.	Amt.	Kind.	Kind	Amt.	Kind	Amt.		Wt.	Per Ct.	Wt.	Per Ct.	Tails	
												Wt.	Per Ct.	Per Ct. Ext.
1			Commercial Tar Oil No 7	#2		Light		Small amt. medium bubbles Float carries much gangue.	2.4	15.3				1.25
2			Fuel Oil No 15			Very light		Very small bubbles. Small amt. of scum. float	1.3	15.8				1.6
3			Atlantic Red No 5.			None		Small fairly rich scummy float.	.5	20.0				3.1
4			Diamond Refined No 6.			None		Small amt. of small bubble Thin scum. no frothing.	1.1	9.8				3.65
5			Standard Heavy Engine Oil			None		Very small amt. dirty float	No sample Too small.					3.15
6			Pine Prod. Flo Oil No 8			Good		Medium bubbles. fairly large froth - carrying much min.	3.2	18.4				3.75
7		#17	do	do	No 9	Light Unstable		Small bubbles - good amt. Carrying much min.	2.4	18.5				2.0
8		#18	do	do	No 10	Much Very Good.		large bubble froth much mineral & more gangue.	24.2	24.6				1.65
9		#22	do	do	No 12	Good Unstable		Fair amt of med. sized bubbles. Unstable. much min.	2.0	32.0				2.05
10		E-2	do	do	No 13	light.		Small bubbles - even froth Froth medium rich.	2.3	34.5				3.0
11			S. F. Cylinder Oil No 16			None		Small amt of float. Poor Grade. Much gangue	5.4	9.2				2.65
12			Cushings Crude Oil			light.		Thin unstable small bubbles Only fair amt of min. float	1.6	20.2				4.15
13			Black Oil No 18.			None		No froth - Only thin film of mineral oil floating	1.0	34.0				1.7
14			Tar Oil No 17			None		do Rich float	.5	17.4				1.2
15		#1	Pine Oil No 6			light Much		Small frail bubbles carrying much mineral. Good amt of froth.	7.9	50.2				1.6
16			Refined Tar Oil No 9			None		No froth. Rich oily scum.	3.2	45.9				2.45
17			Ref. M. Creos. Flo. Oil No 200			light		Rich conc. small bubbles and amt. Scum. much min.	12.8	34.7				2.15
18			Cr. do do do		No 400	Good		Froth fairly stable. Dirty Med. bubbles. Much froth.	10.9	27.5				1.04

Machine

Experimenter

Missouri School of Mines and Metallurgy

FLOTATION LABORATORY.

OPERATING DATA.

ORE

Test No	OIL			REAGENTS		FROTH		REMARKS.	Conc		RESULTS		Tails		Per Ct. Ext.
	No.	Amt.	Kind.	Kind	Amt.	Kind	Amt.		Wt.	Per Ct.	Wt.	Per Ct.	Wt.	Per Ct.	
19		Crude Wd. Terp.	Flo	No 80		Very light		Small bubbles. Unstable Carrying fair mineral	2.0	22.1				—	
20		Spec. Rosin Oil	do	No 15		do		Small frail bubbles grading to scum. Rather dirty	1.5	16.4				1.5	
21		Cr. Wd. Terp.	do	No 75		Unstable		Small unstable bubbles amt of Min. is fair	2.9	21.4				—	
22		Spec. Pine Oil	do	No 1580		Very good Much		Med. size strong bubbles - Much froth - but rather dirty	35.5	14.7				.6	
23		Specific Cr. Wd Oil	No	350		Unstable		Small frail bubbles. Good amt of min in float	3.4	33.2				.75	
24		Pure Pine Oil	Steam Ref #5			Good		Small tough bubbles. Fair amt of min in float.	3.7	23.9				1.55	
25		Flo. Oil No 200	Creosote.			Fragile		Small bubbles - carry fair amt of mineral	1.2	35.7				1.0	
26		Coal Tar Products. Sample No 1				None		Small scum of min floating - No froth	.5	22.4				1.45	
27		do		2		Frail		Small bubble float. Rich float. but small amount.	3.4	45.9				No Zn	
28		do		3		None		Very thin scum of min - Good conc.	1.0	35.1				do.	
29		do		4		None		Slight min bearing film floating. Small amt.	2.3	32.1				1.95	
30		do		5		None		Poor scum of light min. Dirty scum.	1.35	13.0				—	
31		(Water Gas Tar Oil)				None		Thin film of med. grade conc. Small amt.	.7	22.0				2.0	
32		Coal Tar from Gas Ovens.				None		Same - but richer float	3.5	46.8				1.75	
33		Sta. # hagled. & C. Water Gas Tar				None		Slight scummy float Rich in mineral.	1.79	43.1				2.4	
34		Caster Oil				None		Scum of oil and mineral and gangue.	1.3	26.6				1.1	
35		Sperm Oil				None		Poor scummy float Medium grade	.9	17.7				1.85	
36		Corn Oil				None		Small bubble scummy float Poor grade of conc.	4.3	19.9				1.05	

Machine _____
 Experimenter _____

Missouri School of Mines and Metallurgy FLOTATION LABORATORY.

OPERATING DATA.

ORE _____

Test No.	OIL		REAGENTS		FROTH		REMARKS.	RESULTS						
	No.	Amt.	Kind.	Kind	Amt.	Kind		Amt.	Wt.	Per Ct.	Wt.	Per Ct.	Tails	
												Wt.	Per Ct.	Per Ct. Ext.
37			China Wood Oil			None	Some min in float. Small amt of conc.	1.4	24.2					1.6
38			Olive Oil			None	Min. in thin filmy float Small amt. of float.	1.3	21.05					2.65
39			Menhaden Oil (Tech)			Light.	Small bubble scummy froth carrying much min.	2.2	27.35					2.0
40			Rape Seed Oil			None	Scummy froth carrying good amt of min.	3.0	31.1					—
41			Soya Bean			None	Thin film carrying small amount of mineral	1.1	18.9					.25
42			Menhaden Oil (Pure)			None	Very light thin film of min. Small amt.	1.1	23.9					2.35
43			Poppy Seed Oil			Very light	Small amount of small bubble scum which soon grades to scum. Poor.	.69	24.0					—
44			Neat's Foot Oil			None	small scum of min.	2.2	24.3					—
45			Rosin Oil			Very light.	Frailest small bubbles. Froth showing mineral and gauge	2.75	23.6					1.4
46			Cotton seed Oil			do	high rich scummy froth. Not lasting.	5.56	43.7					1.15
47			Paraffin Oil			None	Slight amt of scum.	5.2	24.6					1.15
48			hindsseed Oil Raw			None	same - small amt.	.5	30.8					1.5
49			do	Boiled		Very light.	Small scummy froth carrying some min.	1.36	25.0					1.75
50			Kerosene			do	Ephemeral froth Too small to sample -	—	—					—
51			Coal Tar			None	Slight scum of min floating	3.15	38.5					2.35
52			Oleic Acid			Good	Fair amt of small bobble froth. Fair grade of min.	8.5	33.7					1.5
53			Eucalyptus Oil			Good	Small bubbles. Good grade and amt. of conc. or froth	4.3	48.3					1.0
54			Cresylic Acid			Good	Rich light froth. Bubbles small and frail.	9.5	43.0					1.5

Machine

Missouri School of Mines and Metallurgy

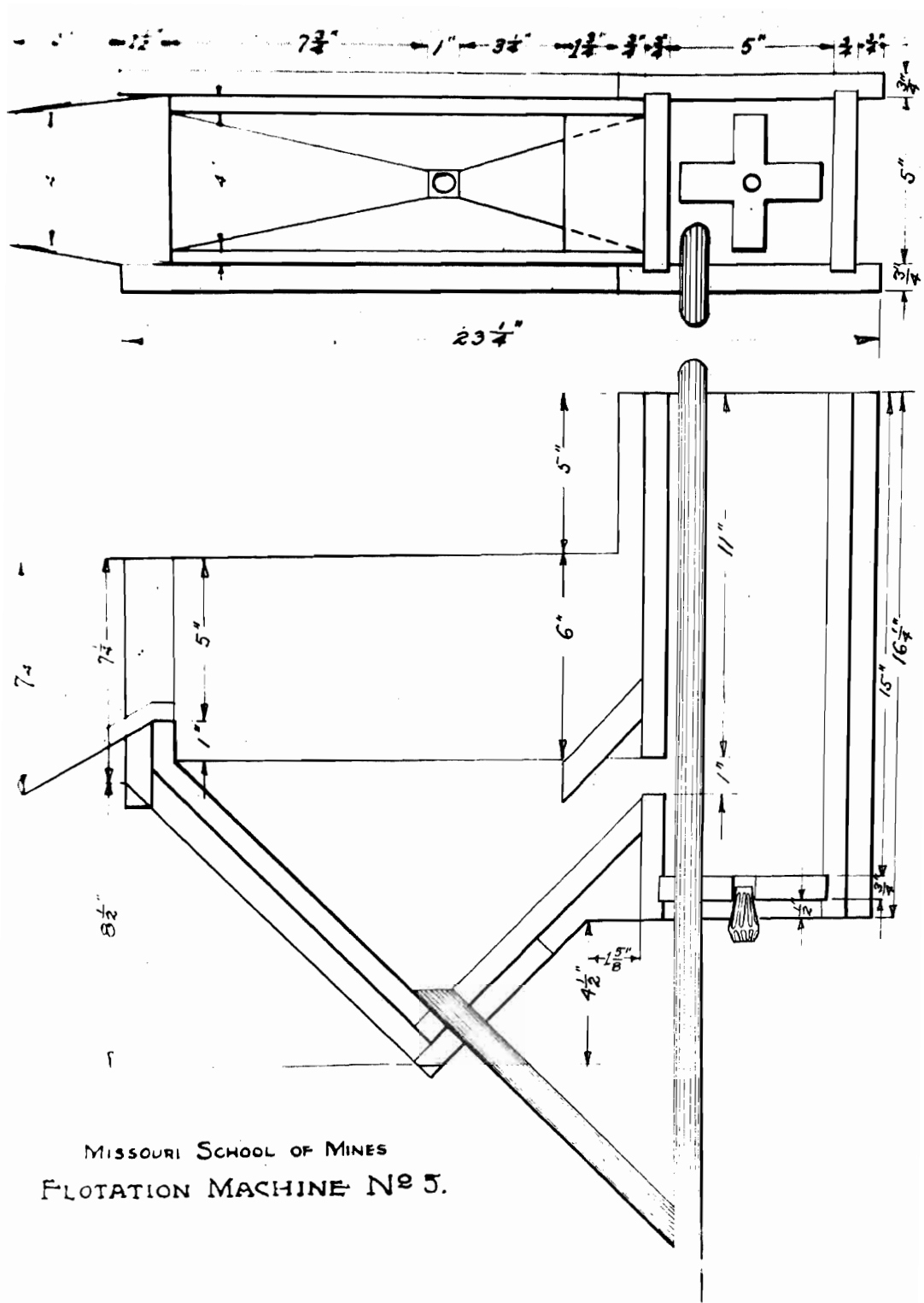
OPERATING DATA.

Experimenter

FLOTATION LABORATORY.

ORE

Test No	OIL		REAGENTS		FROTH		REMARKS.	Conc RESULTS							
	No.	Amt.	Kind.	Kind	Amt.	Kind		Amt.	G15		G15		G15		
								Wt.	Per Ct.	Wt.	Per Ct.	Wt.	Per Ct.	Per Ct.	Ext.
56			Creosote Oil	20%		Fair -ign-	Light small bubble froth grading into scum	3.1	34.7					1.15	
58			Bonetts Flo Oil	No 1		None	Small amount of poor grade float	.4	15.9					1.55	
59			do	No 2		None	do - Better Conc.	1.4	25.5					1.25	
60			do	No 3		Fair	Small bubble frail froth Small amt Rich in min.	2.5	45.3					1.15	
61			Cruce Cotton Seed Oil			None	Small amount of good grade conc.	2.02	25.4					.75	
62			Pancosine			do	Small amount of poor grade float	9.58	20.7					.75	
103	Mix		Cushings Crude	70%		do	Good selection - Small amount of float.	4.5	40.8					2.2	
104	Mix		Cushings Crude	70%		do	Fair amt of scum but poor quality.	1.67	29.5					3.5	
			Creosote	30%											



MISSOURI SCHOOL OF MINES
 FLOTATION MACHINE No 5.

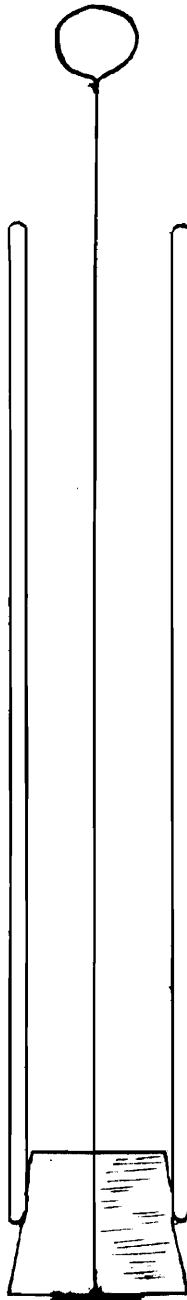


Fig. R.

Diagram showing Sampler Used.

The oil showing the best individual selective properties is No. 53 Eucalyptus Oil.

The oil showing the best frothing qualities is No. 22 Special Pine Oil No. 1580.

The best selector with frothing qualities is the same as the first mentioned, No. 53 Eucalyptus Oil.

The best frother with selective qualities is No. 54 Cresylic Acid.

Errors may have occurred due to any one or all of the following conditions:

1. The machine is of wood, and portions of the oils are often retained in cracks and exert an influence on the action of the oil in the next charge, which influence may materially affect the experiment.
2. The method of sampling.