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The Effects of Preprinted Supplements on a Flotation Deinking Operation

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THE EFFECTS OF PREPRINTED SUPPLEMENTS ON A FLOTATION DEINKING OPERATION

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OBJECTIVE : The objective of this thesis was to see the effects of heavy offset inked supplements on a newsprint flotation deinking operation.

Coated and Uncoated supplements were studied separately and in combination to see what quantities could be allowed to enter into a flotation deinking process without seriously reducing the quality of the resulting paper.

GOAL : The goal of this thesis was to obtain a final product comparable in quality to the material in which these supplements were printed on.

This study should result in the ultimate reuse of a seldom used fiber source and eliminate the added expense of separation.

Introduction : Preprinted supplements are rejected because they are covered with a heavy coating of colored offset ink. Other than black inks, these supplements contain various colored inks. This added to the problem of removal..

Supplements are preprinted using a print that is contracted by a given advertizer. The newspapers have no control over the types of ink applied to these supplements.

The Kalamazoo Gazette charges advertizer by the copy and not by weight. Sunday's supplements are inserted into a human interest section of the Gazette usually on Thursday. A visit to the Gazette was helpful in obtaining a rough idea of the quantity of supplements inserted in 1981. As an example, Meijers in 1981 had over 8 million preprints inserted into the Gazette.

Yearly figures on the percentage of the newspaper that is comprised of supplements were not available. The Gazette has no records of insert skid weights, because they change by the copy. The March 29th 1982 Gazette, that will be represented in this study, contained 70% News and 30% supplements. The 30% total supplements is broken down into 3% coated supplements and 27% uncoated supplements. These percentages vary from day to day. Sunday's newspaper was represented because of the excessive amounts of supplements inserted as compared to the other daily newspapers.

History of Deinking : In 1800 Mathius Koop deinked paper for the first time using Pearl Ash as a deinking agent..[1] Some time

later, Henry Rogers set up the first deinking system in the United States.

Due to chemical and paper shortages during World War II deinking was looked at more seriously. Silicates were utilized to reduce chemical consumption.[2]

<u>Deinking Today</u> : Due to the shortage of virgin forest, deinking is utilized more in Europe than in the United States.

There are, currently, 49 deinking plants located in North America. 45 of these plants are in the U.S. and 4 are in Canada. Of these 49 mills, 19 produce tissue, 11 make printing and writing grades, 4 make liner and boxboard, and 7 make newsprint.[3] In the U.S., Garden State Paper Company is the leader in newsprint deinking. They control 4 newsprint producing mills. They consider preprinted supplements of any type an undesirable fiber source. Garden State employs an extensive sorting procedure to keep supplements out of their system.

<u>The Deinking Process</u> : Deinking is the removal of ink and other non-fibrous materials from a pulp slurry prepared from waste paper. Contaminents such as stickers, metals and heavy inks hinder the utilization of many fiber sources.

Successful deinking must remove inks, coatings, adhesives and other undesirables. This removal is accomplished by repulping with an alkali, soap, dispersant and wetting agents. A storage period to insure full chemical interaction follows the pulping procedure. After coarse screening the pulp is deinked by some

method to remove the ink particles. Common deinking methods include sidehill and press working and flotation of the ink. Deinking is usually followed by bleaching.

The use of deinked pulp has many advantages and disadvantages. Some disadvantages of deinked pulps are high contamination of water effluent, loss of fines and low brightness.

Advantages of using deinked pulp include increased opacity, energy savings. Deinked pulp absorbs less water than virgin pulp. Therefore, there is less tendency to curl. Deinked Pulps also have less tendency to pick.[4]

The savings of money and energy are the most attractive aspects of using deinked pulp. Georgia Pacific, which installed the first flotation deinking system in the U.S., claims a $ 5.8 million savings a year in energy and water.[5] Georgia Pacific also claims a savings of 56 million BTU's a year due to lower cooking temperatures and shorter cook times.

<u>Major Deinking Methods</u> : There are various ways to deink waste papers. Major methods include screw press, sidehill washing and flotation..

Flotation has advantages over the other methods, such as lower water consumption and higher yields. 95-85% yields can be obtained in flotation due to fillers and fines aren't removed effectively.[6]

Disadvantages of flotation include expensive chemicals,

low operational stability and poorer pulp quality.[7, 8] The poor removal of fillers isn't considered a disadvantage of flotation by everyone. Some operations purposely add coated materials to their systems to help prevent ink reabsorption.[7] Most people avoid coated paper because of resulting poor finish control.

Sidehill deinking is accomplished by diluting the pulp with large quantities of water. The diluted stock is passed over a fine meshed screen. Ink, fines, sizing materials and other undesirable materials are removed by passing through the screen. The accepted stock is retained by the screen. Low yields and large water consumption are considered the two major disadvantages of sidehill washing.[9, 10]

Advantages of sidehill washing include low cost, reduced ash content, better removal of ink, and stability. One major advantage of sidehill washing is mixture of waste paper can be handled easier.[8]

Screw press washing has the advantages of higher consistencies, low fiber losses and reduction of chemicals. Screen press deinking is accomplished by dilution of the pulp followed by thickening. The pulp is thickened by squeezing out the water. The water carries ink and filler out of the system.[11]

Important Deinking Steps

A. Groundwood Repulping : Repulping separates ink from the fiber by the means of mechanical and chemical action. The consistency during repulping is usually between 3-6%. Temperature and pH

during pulping are important variables with groundwood papers. Temperatures above 45°C can cause color reversion. If the pH in the pulping process is about 10.5 the lignin will darken. Strong caustic conditions should be avoided. Peroxides are frequently added to the hydropulper to prevent alkali darkening of the lignin.[17]

Alkali conditions are used in ink removal. Alkali swells the fibers and lifts the ink off from the fibers by means of interfiber friction. Hard water is needed to insolubilize soaps. Kalamazoo's water was hard enough, so there was no need to add any additional Ca .

Silicates are utilized in the pulper to stabilize the peroxide. Silicates act as a dispersant and buffer. The buffering action of silicates allow deinking to take place at pH's below 10.5. A dispersant is added in the hydropulper to prevent agglomeration. A detergent is also used to lift the ink from the fibers and form an emulsion.

Of the nonfiberous constituents of waste paper, ink is generally the hardest to remove. Clay dispenses well in the warm hydropulper water. Alkali neutralizes alum and dispenses starches and gums. Alkali also solubilizes rosins, resins and waxes.[12]

To insure full chemical interaction with the pulp a ½ - 1 hour storage period follows the repulping process.

B. <u>Screening</u> : After repulping, heavy metals, such as staples

and metal clips are removed by some means of primary screening. This coarse primary screening is usually carried out on a vibrating Jonsson screen. A centrifugal screen may also be used to remove materials heavier than the fibers.

After primary screening, the stock is usually deflaked to remove entrapped impurities. These newly freed contaminates are removed by a secondary screening.

C. Flotation : Flotation deinking was the method of deinking chosen for this study due to the fact that flotation deinking doesn't remove fillers effectively. Therefore, the effects of these fillers could be examined.

There are various types of flotation cells. The most common cell in use today is made by Voith. There are also Sevemac and Unicell flotation cells. Flotation deinking is usually carried out at consistencies ranging from .8-1.5%.[16]

Flotation deinking relies on the difference in surface conditions of each component of its slurry for effective removal of ink.[13] Flotation operates independently of particle size and specific gravity as other deinking methods do.[13]

Dispersed in and contaminates are removed by the means of foam. The foam is formed by the addition of a frother and collector, and also by the turbulence generated by the impeller. The foam carries contaminates to the surface of the cell where it can be removed.

Flotation deinking is usually carried out in primary and secondary steps. There are usually 5-10 primary cells in series that carry out the deinking of its fiber suspension. The secondary cells reprocess the rejected foam from the primany cells. Stock reclaimed by the secondary cells goes back to the primary cells for reprocessing. The rejects from the secondary cells are sewered.[16]

There are usually three times as many primary as secondary cells. The stock from the first primary cells travels down the whole bank of primary cells, so a total dwell time of 20 minutes is established.

D. <u>Bleaching</u>: Bleaching is carried out in order to get the quality of waste paper near that of virgin pulps. The pulp is thickened prior to bleaching to cut down on chemical consumption and bleaching times.[18]

Peroxides are widely recommended when bleaching papers with high groundwood content. If peroxides aren't present in alkali systems mechanical pulps will darken. Higher yields are obtained with the use of peroxides in bleaching due to lower allowable temperature and shorter resulting cooking times.[18]

Peroxide is a versatile non-toxic bleaching agent. Peroxide is non-volitable and is miscible in water. Peroxides also attack binding materials in waste paper better than alkalis.[18]

Sequence and Sample Types :

Two types of supplements, coated and uncoated, were added to printed news at four levels of addition, 25%, 50%, 75% and 100%. These higher levels of addition were chosen so that even small effects of the added supplements could easily be determined.

These different sequences were examined in this study. In Sequence 1 the levels of coated supplements were varied in order to see the effects of fillers on a flotation deinking operation. In Sequence 2 uncoated supplements were added, at the different levels of addition, to printed news. Sequence 3 is a mixture representing the newspaper studied in this thesis.

The three deinking sequences were compared to a 100% deinked printed newsprint, deinked unprinted news and unprinted untreated news.

SUMMARY OF SAMPLE TYPES AND SEQUENCES

(A) Sequence 1: Coated Supplements and Printed News
1. 25% Addition : 12.5g ctd supps plus 37.5g printed news
2. 50% Addition : 25g ctd supps plus 37.5g printed news
3. 75% Addition : 37.5g ctd supps plus 12.5g printed news
4. 100% Addition: 50g ctd supps

(B) Sequence 2: Uncoated Supplements and Printed News
1. 25% Addition : 12.5g unctd supps plus 37.5g printed news
2. 50% Addition : 25g unctd supps plus 25g printed news
3. 75% Addition : 37.5g unctd supps plus 12.5g printed news
4. 100% Addition: 50g unctd supps

(C) Sequence 3: Mixture of Both Supplements and Printed News

1. 25% Addition : 2.9g ctd supps plus 9.6g unctd supps plus 37.5g printed news
2. 50% Addition : 5.75c ctd supps plus 19.25g unctd supps plus 25g printed news
3. 75% Addition : 8.63g ctd supps plus 28.87g unctd supps plus 12.5g printed news
4. 100% Addition: 11.5g ctd supps plus 38.5g unctd supps

(D) Comparison samples

1. 100% Printed News : 50g printed news
2. 100% Unprinted News : 50g Gazette Base Stock
3. Unprinted Base Stock : No Treatment

EXPERIMENTAL LABORATORY WORK

Procedure : The Pulping Chemicals were added to hot tap water at 45°C. 50 g samples were added to the 9.5 pH bleaching liquor and pulped at 3% consistency at low speed in the 1 gallon Waring Blender for 2 minutes. (See summary of procedure for chemical additions and conditions). The slurry underwent a 20 minute dwell time to insure full chemical interaction.

Summary of Pulping Procedure

1. 50 g Samples
2. 1665 ml Hot Tap Water (45°C): 3% Pulping Consistency
3. 1% H_2O_2 (.5g)
4. 1% Oleic Acid (.5g)
5. 4% Silicates (2g) : G.E. AF-96
6. .1% TSPP (.005g)
7. .2% Detergent and Wetting Agent(01) : Arosurf 63 PE-16
8. pH 9.5
9. Pulp for 2 minutes at low speeds
10. Let mixture stand for 20 minutes

The pulped samples were transferred to the Voith Laboratory Flotation cell. Enough cold tap water was added to bring the level of the cell to 15 liters. .1% of TSPP was added to the pulp in the cell to help redisperse any ink that may have redeposited. The consistency in the cell was approximately 1%. A constant flow rate of 100 ml/min of cold tap water was required

to maintain a high enough level in the cell for ink removal. A 20 minute dwell time in the cell was established. Original trials were carried out at a 30 minute dwell time. Fiber losses exceeded the established allowable level of 15%, so the dwell times were cut to 20 minutes.

A 15% fiber loss was decided upon since this is about a normal fiber from primary cells in production equipment. All flotation deinking operations carry out a secondary treatment and claim about 8% loss of total input. The samples in this study underwent a primary treatment, therefore, a 15% fiber loss must be allowed for.

The rejects from the flotation cell were drawn down on the büchner and dried in an oven at 105°C. The dried reject pads were then weighed to determine the fiber loss.

The accepted pulp from the flotation cell was removed and condensed on a Büchner funnel. The condensed pulp pads were rinsed with hot tap water to remove the pulping chemicals from the pulp. 2.5% Silicates were added to the pulp prior to the bleaching chemicals. After the silicates were thoroughly mixed into the pulp, 1.5% Zinc Hydrosulfite was added. The pH during the bleaching stage was maintained at 9.5. The pulp was bleached at a 10% consistency for 2-3 hours. The bleach was allowed to stand on the pulp to ensure total exhaustion of bleaching chemicals.

The washed bleached pulp samples were made into standard 2.5 g handsheets on the Noble & Wood handsheet apparatus. Bright-

ness and dirt counts were obtained on each handsheet. Ash content was determined on the samples containing fillers. Brightness, dirt count, and ash values were examined to determine the effectiveness of the process.

The above procedure was followed for each sample type.

<u>Discussion of Results</u> : The final brightness of the deinked handsheets depends on numerous factors, percent addition, dirt count, ash content and fiber loss are all taken into account. The most important factor in determining the final brightness of the sheet is the percentage of addition of the supplements. The percent addition of supplements into the furnish governs what the dirt count and ash will be.

Examination of Table 1 shows that the addition of coated and uncoated supplements (Sequence 2 and 3 respectively) data follows the expected trend of decreasing brightness with increasing supplement addition. The coated supplements (Sequence 1) scattered values can be explained by looking at the ash values. Flotation deinking doesn't remove fillers effectively. Therefore, any filler remaining in the system will contribute to the overall brightness of the handsheets. The 100% addition of coated supplements had the highest filler content and resulting in a higher brightness. The brightness values for the coated supplements were related to the ash content. The 50% addition of coated supplements had a low ash content, which resulted in the lowest overall brightness level in Sequence 1.

Graph 1 shows a plot of brightness v.s. Percent Addition of supplements for each sample type. Graph 1 shows that addition the samples containing coated and uncoated supplements does follow the expected trend of decreasing brightness with increasing levels of addition. It would seem that the mixture (Sequence 3) should have a higher overall brightness than the uncoated supplement additions (Sequence 2) due to the ash content of Sequence 3.. The uncoated sequence had a lower overall dirt count (See Table 1) than Sequence 3. Therefore, Sequence 3 had a lower brightness than Sequence 2 due to the higher amounts of in specks. The ink and filler form somewhat of a balance to give the mixture a brightness comparable to the uncoated supplements.

Graph 1 shows that percent addition does affect the coated supplement data. The larger the percent addition the more filler can remain in the system. Almost all of the points for coated supplement addition (Sequence 1) show an increase in brightness with increased levels of addition. This expected trend is due to the presence of increasing amounts of filler remaining in the system. The 50% addition of coated supplements follows the expected trend. It would seem the 50% addition would have a higher brightness than the 25% addition of coated supplements due to the increased amount of filler put into the system.

Graph 2 is a plot of Brightness v.s. Dirt Count. Graph 2 shows that as dirt count increases brightness as expected decreases. There are two points of variance on Graph 2, the 75% addition of uncoated supplements and the 100% mixture sample.

Due to numerous small ink specks on the handsheets these two points have a low brightness and a low dirt count.

Graph 3 is a plot of Percent Addition v.s. Dirt Count for uncoated supplements (Sequence 2). The absence of filler means Sequence 2's data is not governed by ash content. Sequence 2's data is a reflection of how effective this study was. Graph 3 shows that there was an overall use in dirt count with increased levels of uncoated supplement addition. The increase in dirt count is due to the increased amount of heavy colored inks entering into the system. The 75% addition of uncoated supplements data varies from the norm because the ink particles were severely broken down into tiny ink specks. This resulted in the lowest dirt count for the sequence.

Table 1 also shows an increasing dirt count trend with percent addition except for the 2 points in which the ink particles were severely broken down. Table 2 shows for Sequence 2 and 3 a decreasing brightness analogous with an increasing dirt count, except for the 75% addition of Sequence 2 and the 100% addition of Sequence 3. These values have a low dirt count and a low brightness for reasons explained earlier. Table 1 shows that the dirt count in Sequence 1 does increase with percent addition of coated supplements. But, as stated earlier, the high ash content in Sequence 1 handsheets outweighs the high dirt count to give the handsheets an increasing brightness.

<u>Fiber Loss</u> : Fiber Loss was not maintained at a constant level during this study because it would be very difficult to control,

as long as the fiber loss was maintained below the established 15%, the samples were accepted. No comparison can be made of the effects of fiber loss on brightness and dirt count because it was uncontrolable. The amount of ink, fiber or filler removed by the froth could not be controlled, therefore the effects of fiber loss on this study could not be noticed.

<u>Ash Content</u> : Flotation deinking does not remove all of the filler from the sheet as other methods do. Some filler is removed during flotation, but the amount removed is difficult to control. The difficult filler removal leads to fluctuations in furnish quality. Final brightness of the sheets will vary with the amount of filler remaining in the sheets.

Coated supplements data in Table 1 represents the effect of ash content on final brightness. The 50% addition of coated supplements has the lowest ash content and also the lowest resulting brightness. The remaining levels of additions show brightness gains in accordance with the amount of ash in the sheet.

The data for the mixture in Table 1 also shows an increasing brightness, with increasing ash content. The mixtures data also reveals the difficulty of filler removal in a flotation deinking process. The higher levels of supplement addition contained more coated supplements than the lower levels of addition, yet the lower levels of addition had a higher ash content than the higher levels of addition.

Graph 4 is a plot of brightness against ash content for

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Graph 4 is a plot of brightness against ash content for

coated supplements and the mixture. It is evident from this graph that brightness does increase with increasing ash content. The coated supplements contained more filler than the mixture, therefore the coated supplements have a more exaggerated brightness than the mixture.

Conclusions : The results of this study gives hope that a level of addition approaching 25% addition of uncoated supplements and a combination of coated and uncoated supplements can be utilized in a flotation deinking process. A more detailed final bleaching sequence and a lightweight ink removal system could help a deinking plant obtain 20-25% levels of addition of uncoated supplements with brightness comparable to unprinted Base stock. This study was not only effective in obtaining acceptable brightness losses, but effective ink removal was also obtained in this study. Table 1 shows the uncoated supplements and the mixture had a slightly lower dirt count than the deinked printed news control. The 25% addition of uncoated supplements and of the mixture had brightness levels that were 4.5% lower than the 3 control samples (see Table 1). This gives hope of utilizing these coated and uncoated supplements and lower waste and a portion of the separation cost. Since the 25% level of addition of both uncoated and coated supplements is approximate the maximum that can be expected (as in the Sunday, March 29, 1982 edition). It appears practical to utilize all waste papers as received and accept the small loss in brightness and slightly higher dirt count.

Coated supplements should remain a small portion of the

furnish because of the difficult filler removal and resulting poor paper quality. It would not be advisable to go above the 6% coated supplement addition as represented by the 25% mixture addition.

This study fell short of its established brightness goals. The 4-5% difference can be made up with an extensive final bleaching or small addition of virgin pulp or unprinted stock, and lightweight ink removal. The dirt count data shows this study was effective in removing the ink from the 25% addition of Sequence 2 and 3. These two dirt count values were actually lower than the control value. Therefore, it would seem a better final bleaching is needed to obtain an acceptable brightness.

Recommendations for Further Study: As mentioned extensively throughout this paper, there is a definite need for development in the area of bleaching and lightweight contaminant removal. Also another method of deinking, such as screw press or sidehill, could result in better results.

Anyone undertaking a project similar to this study should maintain temperature and pH at constant levels. Also it is important to keep the time between the pulper and flotation cell under 1 hour. The peroxide becomes exhausted after an hour and alkali color reversion takes over. Three trials in this study needed to be repeated because of this hour time limit was exceeded and color reversion took place.

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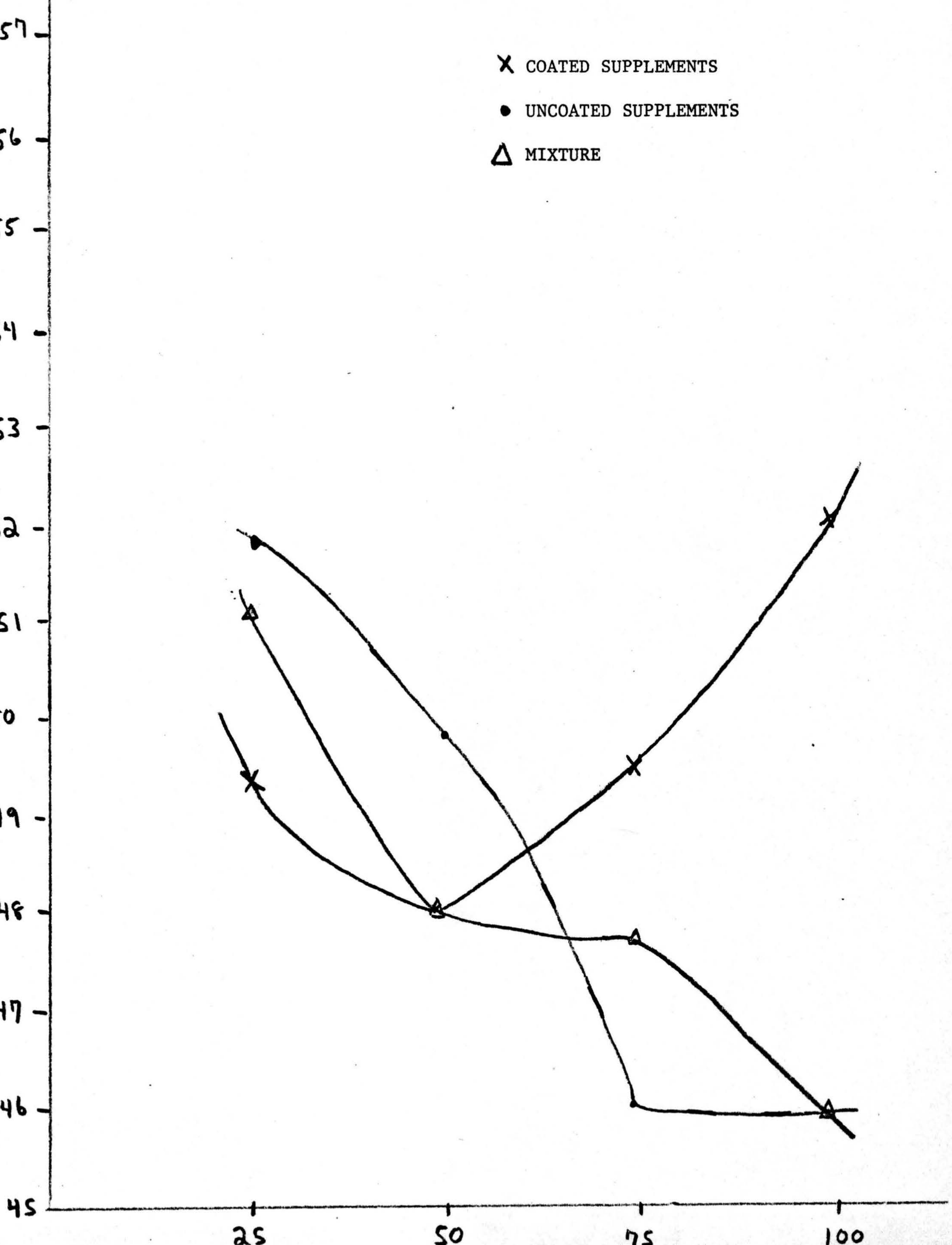
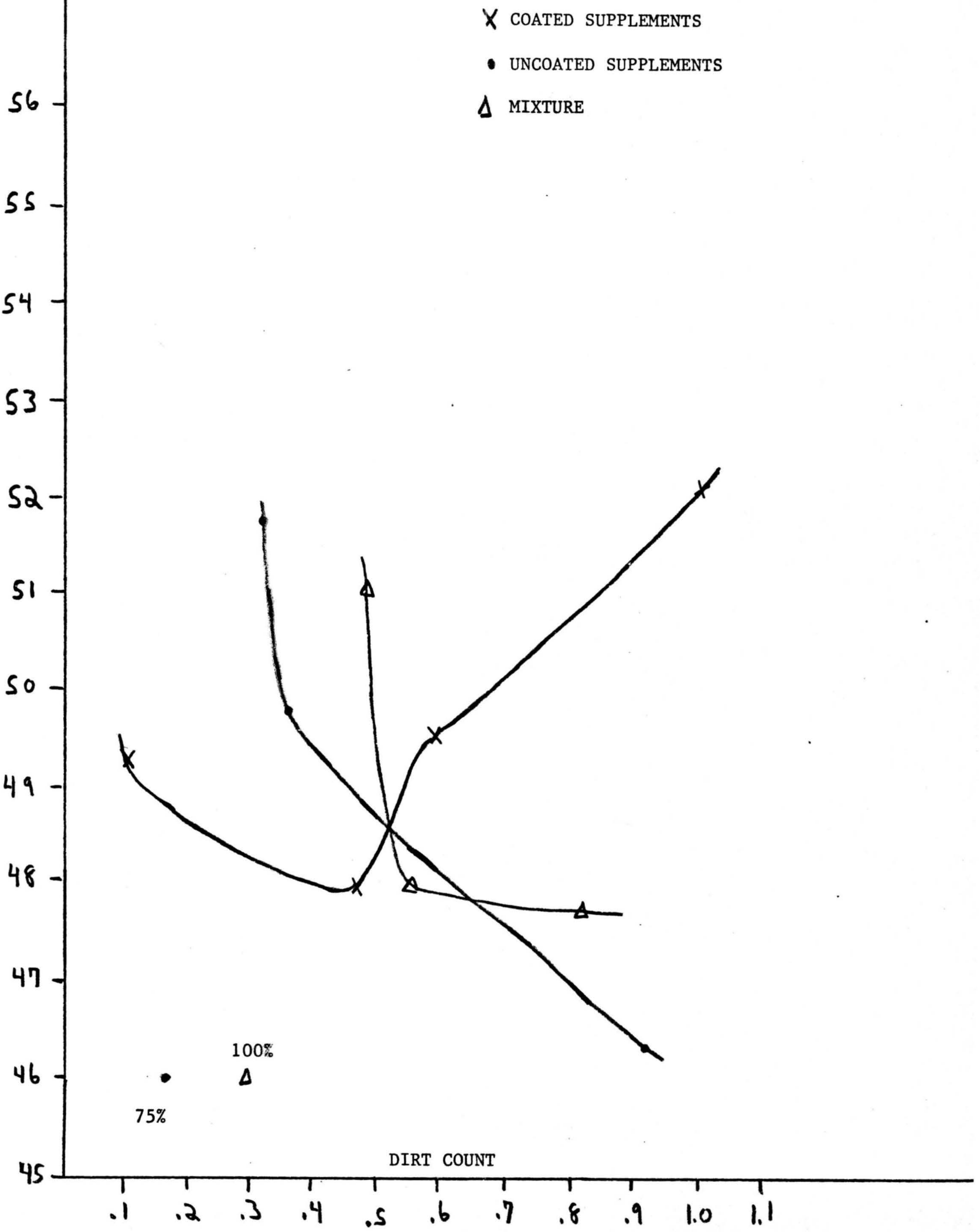
APPENDIX

Table 1	25%	50%	75%	100%
Sequence 1				
Brightness	49.31	47.96	49.5	52.12
Dirt Count	.10	.46	.58	1.08
Ash	9.81	9.74	9.80	9.85
Fiber Loss	9.8	13.2	13.4	14.8
Sequence 2				
Brightness	51.70	49.75	45.99	46.02
Dirt Count	.31	.35	0.175	.91
Ash	-	-	-	-
Fiber Loss	8.7	10.6	12.5	10.4
Sequence 3				
Brightness	51.1	48.06	47.77	46.02
Dirt Count	.47	.54	.81	.33
Ash	5.58	4.70	9.4	11.2
Fiber Loss	8.2	11.6	4.75	7.5
100% Printed News				
Brightness				56.3
Dirt				.475
100% Unprinted News				
Brightness				56.63
100% Unprinted (N.treatment)				
Brightness				56.73

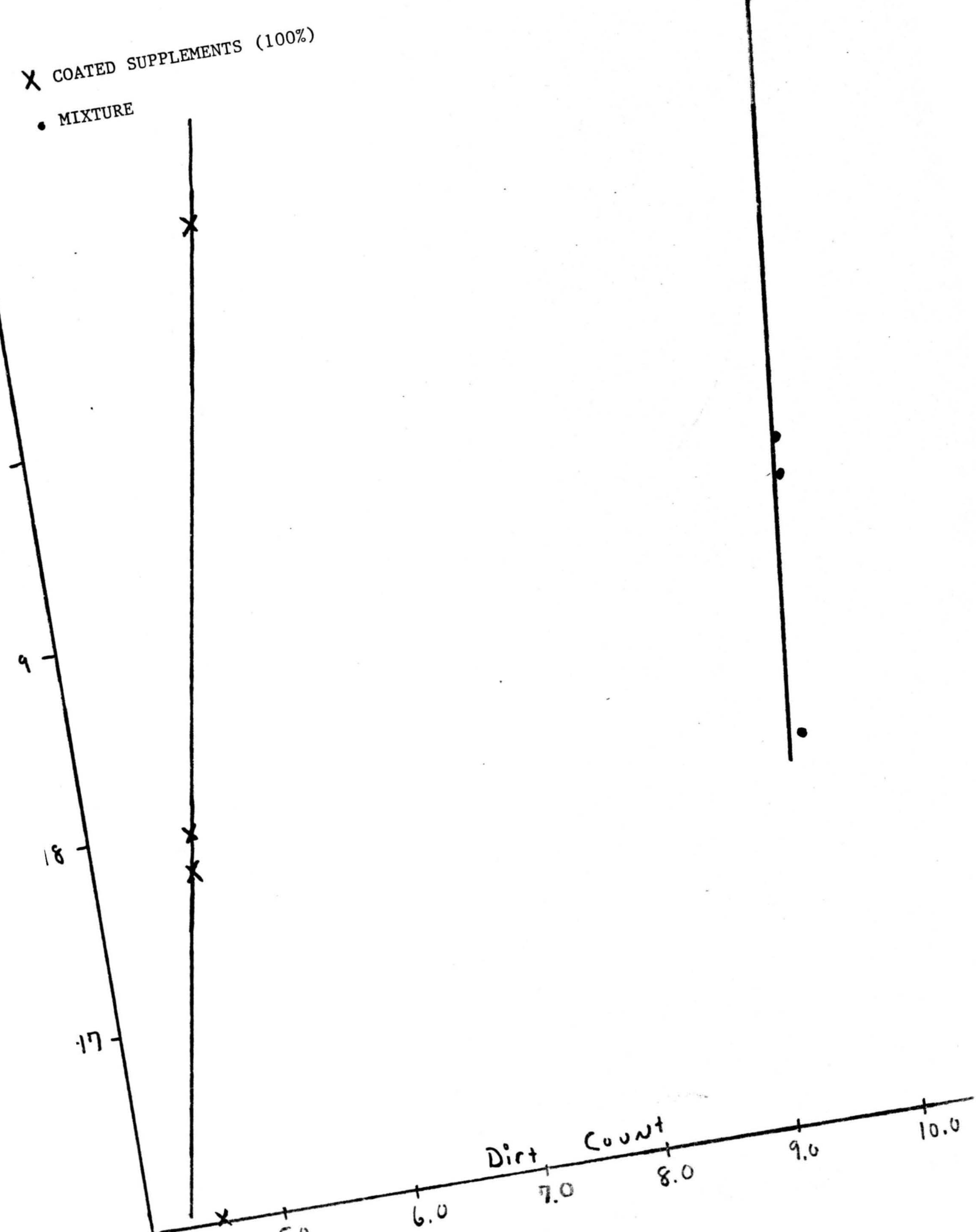
GRAPH 1: % ADDITION v.s. BRIGHTNESS



GRAPH 2: DIRT COUNT v.s. BRIGHTNESS



PH 3: ASH CONTENT v.s. BRIGHTNESS



GRAPH 4: DIRT COUNT v.s. % ADDITION OF UNCOATED SUPPLEMENTS