



4-1979

The Optimum Process for Recycling One Time Carbon Snap Out Forms

Douglas E. Bender
Western Michigan University

Follow this and additional works at: <https://scholarworks.wmich.edu/engineer-senior-theses>



Part of the Wood Science and Pulp, Paper Technology Commons

Recommended Citation

Bender, Douglas E., "The Optimum Process for Recycling One Time Carbon Snap Out Forms" (1979).
Paper Engineering Senior Theses. 47.
<https://scholarworks.wmich.edu/engineer-senior-theses/47>

This Dissertation/Thesis is brought to you for free and open access by the Chemical and Paper Engineering at ScholarWorks at WMU. It has been accepted for inclusion in Paper Engineering Senior Theses by an authorized administrator of ScholarWorks at WMU. For more information, please contact wmu-scholarworks@wmich.edu.



THE OPTIMUM PROCESS FOR
RECYCLING ONE TIME
CARBON SNAP OUT FORMS

By

Douglas E. Bender

A Thesis submitted
in partial fulfillment of
the course requirements for
The Bachelor of Science Degree

Western Michigan University
Kalamazoo, Michigan

April, 1979

TABLE OF CONTENTS

	<u>Page Number</u>
Abstract.....	11
Introduction.....	1
Theoretical Discussion.....	2
Experimental Procedure.....	3
Results Presentation.....	7
Discussion of Results.....	8
Conclusions.....	16
Recommendations.....	17
Literature Cited.....	18
Appendix I.....	19
Appendix II.....	20
Appendix III.....	21
Table I.....	22
Table II.....	23

ABSTRACT

The objective of my thesis was to determine the optimal process for recycling one-time carbon snap out forms. The emphasis of my project was placed on attempting to remove the ink present in these forms. In so doing, it was felt that the recovered ink-free fiber might be useful in an industrial application.

Through experimentation in the laboratory it was found that flotation deinking did an adequate job removing ink. Furthermore, other methods considered such as solvent deinking and cyclone cleaners did not do an acceptable job removing ink. It can be concluded that flotation deinking will do an acceptable job at removing ink from one-time carbon snap out forms.

It is recommended that flotation deinking utilizing the Voith Warden Deinking Cell be recognized as the optimum process for deinking one-time carbon snap out forms. The chemicals which were found to give the best results were caustic sodium silicate, potassium soap, and Triton X-100.

INTRODUCTION

The objective of this thesis was to determine the optimum process for recycling one-time carbon snap out forms. Special emphasis was placed on removing the ink from the forms. It was felt that if the ink could be removed from the forms the recovered fibers would be valuable to some industrial application. The carbon snap out forms are presently being recycled and used in roofing felts, but no process was uncovered in the literature survey in which these forms were being deinked.

There are three major reasons why this project was undertaken. First, there has been an environmental trend on a nationwide scale to recycle whenever feasible. Secondly, the economics of recycling will become more rewarding as the price of virgin pulp rises. Finally, it is estimated that there is a 200,000 ton per year surplus in converters waste of these snap out forms. One can readily see that a process which adequately removes the ink from these forms could possibly be instituted industrially either now or in the years to come.

THEORETICAL DISCUSSION

Very little work has been done to find a process by which one time carbon snap out forms can be deinked. Currently, the only known use for these forms after being recycled is filler for roofing felts. No data was procured during the literature review of anyone trying to deink these forms. Possible reasons for avoiding deinking these forms may be for the massive amounts of ink as well as the wax that is present.

In the flotation deinking process it is felt that the ink particles are attaching themselves to the wax particles. The collectors, the potassium soap and the sodium silicate, are aiding in keeping these particles dispersed and not allowing them to redeposit on the fibers. The Triton surfactant is forming surface tension which aids in foaming. As the air is introduced in the cell, the lighter weight ink and wax particles adhere to the bubbles. They should float to the surface faster than the fibers to get maximum efficiency. The froth is swept away mechanically and the recirculated fibers are introduced at the bottom of the cell with the air. It is felt that the chemicals being utilized are producing slightly different foaming characteristics. The foam being produced on the laboratory flotation cell has a tendency to burst or collapse. The effect is still good ink removal but less fibers are being floated, hence a higher yield.

EXPERIMENTAL PROCEDURE

The process I followed for flotation deinking in the lab utilizing the Voith Morden Deinking Cell was as follows. The calculations for the chemicals were made based on a four percent consistency cook. The chemicals were weighed out and diluted in the tap water necessary to bring the cook to the desired four percent. In a metal beaker, approximately ten liter capacity, the chemicals were agitated in the water while being heated to a temperature of 55°C on the steam bath. Time to temperature using this method generally lasted 6-8 minutes. As the chemicals were being heated, the carbon forms were torn into 1-2 inch squares. When the chemicals reached the desired temperature, the steam bath and agitation were turned off. The beaker would be left on the steam bath to encourage heat retention. The carbon forms would be added to the chemicals and allowed to soak for 5 minutes at which time the agitation was applied to beat the forms into pulp. I found it necessary to beat the fibers for 10-12 minutes violently to ensure good breakdown of the fibers because of the small groundwood content that was present. After the forms were thoroughly beaten they were emptied into the Voith Morden Deinking Cell. The Voith Morden used was the fifteen liter capacity unit designed specifically for research. Cold tapwater, approximately 17°C , was used to dilute the stock down to the desired .6% consistency. The flotation cell was run on an average of 10-12

minutes.

Only accents from the main body on the deinking cell, where the air is introduced, were used to make handsheets. It was felt that the area of foam removal and recirculation area contained some ink particles that were not indicative of the ink that was removed. In an industrial application these fibers would be guided into another deinking cell in series.

Initially, the work performed with the flotation cell did not take into account either pH or yield. In certain cases all the fiber floated directly to the surface making ink removal impossible without losing a very high percentage of fiber. In these cases, neither a yield or handsheets were obtained because they were not considered feasible deinking processes for this furnish. As my work progressed the pH and yield were evaluated to help make comparisons with past performances as well as determining new directions to approach. The following experiments made on the Voith Morden Deinking Cell in the laboratory follow the procedure outlined above unless I specify otherwise.

The pilot plant trial utilizing the Voith Morden Flotation Cell was an attempt to duplicate the most successful trial run in the laboratory. The chemicals used were based on cook #13 of Table 1 and are outlined in Appendix III.

The proper amount of water (300 gallons) to pulp at five percent consistency was added to the hydropulper. The temperature was raised to 130°F before the carbon forms were introduced. The forms were beaten in the hydropulper for about 40 minutes. The chemicals had been prepared, diluted and raised to 130°F in a

metal tank of approximately 100 gallons capacity. The volume necessary to achieve 20 lbs. of carbon forms was determined from a chart. The proper amount of stock from the hydropulper was pumped to the tank which contained the chemicals to achieve a cook of four percent consistency. The contact between the chemicals and the fibers was approximately 30 minutes. During this time manual mixing was used to encourage fiber and chemical contact. The slurry was introduced to the flotation cell manually with the aid of five gallon pails. Once in the flotation cell, the stock was diluted to the desired 0.6% consistency with cold water from the nearby line. The flotation cell was adjusted to encourage the proper flowage through the cell and was run for 30 minutes. Accepts were taken from the main body of the cell for comparisons to be made with laboratory results. The remaining stock was emptied into the closest chest. From this chest the stock was passed through both the Bergstroms and the Bird Tricleans. It was hoped that the cyclone cleaners would remove the remaining ink and wax conglomerates. Accepts and rejects were taken from their perspective places to determine whether additional contaminants had been removed by the cleaners.

The softening point of the wax present in the carbon forms was found to be 113-114°F.¹ It was shown that under the right conditions the wax and ink would conglomerate and float to the surface of the stock. It was felt that if these conditions were met and the stock was introduced to the cyclone cleaners, efficient wax and ink removal may result. The advantage of ink removal in this process would be the reduction in heating the stock and

1. This figure was determined in the first semester's thesis work. It is found on page 3 of my paper.

chemical useage. Appendix II outlines the details of this trial.

One hundred twenty-five pounds of carbon forms were beaten in the hydropulper at three percent consistency. The pH was adjusted to ten using caustic. The slurry was pumped into two chests with as equal volumes as possible. One chest was diluted to .52% consistency to feed the Bergstroms and the Bird Tricleans. The other chest was diluted to .86% consistency, the target was 1.0%, for the Albias which can be run efficiently at higher consistencies. After diluting both stocks to desired consistencies, the pH of each was adjusted to approximately 10. The steam pipe was introduced to both slurries which raised the temperature to 113°F and aided in mild agitation. The slurries were then introduced to their respective cyclone cleaners. Accepts and rejects were taken from the proper lines in each case and compared to results of the flotation deinking method.

A wax extraction was performed to determine the percentage of wax based on weight present in the carbon forms. The procedure followed was in accordance with Tappi Procedures T 405 ts-63. Toulene was the chemical solvent used to make the extraction. The wax content of the carbon forms that were used in all processes was determined to be 4.92% by weight. Appendix I outlines the calculations necessary to find this figure.

RESULTS PRESENTATION

The results of the trial run in the pilot plant utilizing the cyclone cleaners were negative. A sufficient amount of ink was produced when samples were collected from the accepts lines from each of the Tricleans, Bergstroms and Albias. The rejects were indistinguishable from the accepts in each case. Furthermore, the ink and wax appeared to conglomerate and form large particles which would readily show up in handsheets.

The pilot plant trial using the Voith Morden Deinking Cell and then the Bergstroms and Tricleans was also negative. The accepts from the flotation cell contained many large conglomerates of ink and wax. These particles were much like those found after using the cyclones mentioned in the previous paragraph. After the flotation cell the stock passed through the Bergstroms and Tricleans. The accepts and rejects were indistinguishable because both contained large quantities of ink and wax conglomerates. It should be noted, however, that the Bergstroms and Tricleans did clean up the stock somewhat.

The results of the laboratory deinking cell trials have been summarized in Table II.

DISCUSSION OF RESULTS

It was found that neither the Bergstroms, Albias, nor the Bird Tricleans adequately removed the ink from the stock. It is worth mentioning that the ink and wax were clearly separated from the fibers before entering any of the cleaners. The wax and ink were clearly lighter than the fibers because they floated readily in the stock suspension. However, none of the cyclone cleaners did a good job in distinguishing the differences in specific gravities between the contaminants and fibers. The only explanation that can be offered in behalf of the cleaners is that the normal operating temperatures are approximately 130°F, and the temperature of this stock was only 113°F.

The preliminary work done in the laboratory using the flotation deinking cell was aimed at finding a combination of chemicals that would adequately remove the ink from the carbon forms. In the first trial it was found that at a very high chemical percentage the chemicals selected worked well. Admittedly, this was lucky because one could spend many months and not find a good combination. From this point it was decided to use these same chemicals and attempt to find the minimal amount needed to achieve the same results. Refer to Table I for the chemical constituents in the following discussion.

The first cook used a large amount of sodium silicate, potassium soap, caustic, and Triton surfactant. The potassium soap and Triton CF-10 showed excellent foaming characteristics in that there was not an over-flow of foam. The potassium soap (constituents in

Appendix IV) shows favorable signs of scum formation. The ink particles were relatively fine with a few conglomerates appearing in the Noble and Wood handsheets. In general, the ink remaining was well dispersed in the handsheets. Trial one indicates the chemicals used may be effective in ink removal. However, at this level of addition the process is not economically feasible. The next trial should be aimed at reducing chemical usage.

In trial two the decrease in sodium silicate and increase in caustic produced very similar results to the first trial. The ink particles were small and well dispersed in the handsheets with a few conglomerates still visible. After approximately five minutes in the flotation cell the fibers began to float to the surface. It is still necessary to reduce the chemical input to find a feasible solution. In the next trial the sodium silicate will be decreased while the other chemicals remain the same.

Trial three attempted to reduce the chemical consumption from 13.4% in the previous trial to 9.4%. Unfortunately, after pulping the carbon forms the stock was emptied into the flotation cell only to find the ink and wax had plated out on the sides and bottom of the metal beaker. Therefore, there was no point in running the flotation cell. Trial four will attempt to eliminate sodium silicate and Triton surfactant.

Trial four eliminated both sodium silicate and the Triton surfactant. This trial was meaningless from the chemical input standpoint. When the stock was introduced to the flotation cell the air valve was not checked. When the cell was turned on the air was introduced very abruptly and the fiber floated directly to the surface. A defoamer was used but to no avail, the fibrous

mat would not redisperse. One valuable lesson was learned from this experience and was used thereafter when operating the flotation cell. When the flotation cell is turned on the air valve should be closed. This will allow the suspension to be mixed well when the air is introduced. It is also beneficial to close the recirculation valve so that air will be introduced before the suspension is thoroughly mixed. In the next trial only the Triton will be excluded. This may lead to some conclusions about the potassium soap.

In trial five the chemicals were increased to 7.6% as compared to 3.8% from trial four. The sodium silicate was used in this trial but the Triton surfactant was not. The ink particles formed were smaller in comparison than in trial four. There was not a high level of foaming in the deinking cell but scum formed nicely. The fibers were floating to the surface and a fiber mat was nearly produced. It is possible that the pH of 11.9 could be contributing to this. As a result the yield loss appeared to be high. The handsheets showed medium sized ink conglomerates uniformly dispersed.

The sixth trial was an attempt to duplicate the misfortune of trial four. The only difference was this trial had slightly more caustic than four. This trial proved to be unsuccessful because the ink and wax formed conglomerates larger than those in the previous trial. The foaming was terrible, nearly negligible, so ink separation from the fiber was not adequate. Furthermore, the ink that did float was attached to fibers which did not aid in ink removal. The Triton surfactant needs to be used to encourage good foaming characteristics.

The seventh trial was aimed at cutting back on the potassium soap consumption and eliminating the caustic. The ink separated readily from the fiber but shortly after the deinking cell was started the fiber floated to the top to form a mat. Thus far the trials have not followed a logical pattern. It is time to start back with the initial trial that showed good results and work on the chemical consumption reduction in an orderly manner. It is apparent that all the chemicals utilized thus far should be used together to obtain acceptable results.

Trial number eight was a duplicate of trial one except that in eight the consistency in the flotation cell was 0.6% as compared to 0.8% for number one. The foam characteristics were excellent, enough foaming and scumming to effectively remove the ink. The handsheets made therefrom are almost ink free. Definitely the best thus far. The next trial will cut the sodium silicate usage by $\frac{1}{2}$ and potassium soap by $\frac{1}{4}$ while all the other chemicals remain the same. A substitution is necessary as Triton CF-10 is no longer available, so Triton X-100 will be used.

In trial nine the ink and wax appeared to separate well from the fiber during the cook. Once in the deinking cell, the separation became more apparent as the wax and ink formed a distinct layer at the top after dilution. While running, almost all the ink was removed in the first minute. The foaming was more severe in this trial than in past trials and the fibers started working their way to the surface after a short time. The mat formed could be due to the new Triton utilized because Triton X-100 is a super foamer. The next trial will reduce usage of sodium silicate,

caustic, and Triton X-100. Trial ten was quite similar to nine except handsheets were obtainable because the stock did not float to the surface in the deinking cell. The foaming was still more than necessary so that ought to be reduced. The handsheets made had medium sized ink conglomerates here and there, but generally looked very good otherwise. Some brown fibrous material showed up in the handsheets which is believed to be groundwood. This means the stock should be more thoroughly pulped during the cook. The next trial will cut back on all the chemicals a little and pulp the fibers longer during the cook.

Trial eleven was very successful in that the highest brightness was achieved thus far with very good ink removal. The foaming in the flotation cell was very good because the ink and wax particles were well dispersed and distinctly separated from the fibers. The corresponding yield was the highest to date too. The handsheets made looked almost as good as trial eight except for the ink particles that were here and there. In the next trial the caustic will be lowered. The lower caustic should drop the pH to around 9.5 which may be beneficial to the groundwood content. Also, the Triton will be decreased because there has been an abundance of foam in every trial and only .2% or so should be necessary.

In trial twelve the ink conglomerates were noticeably larger than any found in trials eight thru eleven. The pH was down to 9.4 which was desired in this run. The foaming fell a little short of what was expected. The handsheets showed the ink conglomerates too readily to try this trial again. The next trial will go back to previous levels of chemical additions as in trial

eleven, but the Triton will be lower than in eleven.

Trial thirteen showed excellent foaming characteristics even with the low level of Triton being added (.33%). The ink particles were small and well dispersed in the handsheets with only occasional visible ink spots. The brightness achieved was 46.2, only .2 points short of trial eleven which had $3 \frac{1}{3}$ times as much Triton. At this point the ink is being removed quite effectively so in the next trial sodium peroxide will be added to try and improve the sheet brightness.

Trial fourteen had the same makeup as thirteen except for the addition of 2g of sodium peroxide. The trial itself was almost identical to trial thirteen. All the ink was finely dispersed and the handsheets were indistinguishable from those made in trial thirteen. The brightness values, for all practical purposes, were equal. Therefore, the addition of sodium peroxide was useless. In the next trial a double collector will be used to see if ink removal will be enhanced.

In trial fifteen 2g of toluene were added in addition to the chemicals used in trial thirteen. The ink conglomerates were the largest witnessed of all trials thus far. The handsheets looked very good between the monstrous sized blue ink spots, but would never be accepted unless these ink particles were thoroughly removed. The results, delete the double collector approach for the time being. It may be a feasible process but I would not encourage anyone to try toluene again with the chemicals being used in this trial.

The final trial was an attempt to duplicate trial thirteen again with the higher caustic addition, all others being equal.

This would hopefully show that the Triton X-100 would be lowered yet and still produce the desired foam characteristics. The pH, yield, and brightness were all very close to one another but this trial showed slightly larger conglomerates than in thirteen. Therefore, it is recommended to leave the .333% Triton addition alone and work on reducing the sodium silicate, potassium soap, and caustic additions.

The results obtained during the pilot plant trial utilizing the Voith Morden Deinking Cell, Bergstroms, and Bird Tricleans may not be in vain. There are a number of explanations as to why the results were negative compared to the preliminary laboratory work. It should be noted that the procedures followed in the pilot plant did not follow those procedures used in the laboratory to determine the optimum process.

In the lab the chemicals were mixed in a beaker prior to the introduction of carbon forms. After mixing the chemicals, as the temperature was raised to the desired value, the paper was allowed to soak for five minutes. The soaking period allowed chemical interaction and softened the fibers for pulping. The fibers were then pulped at four percent consistency. In the pilot plant the carbon forms were pulped at five percent consistency in water at 130°F. The chemicals were prepared separately before the introduction of the fibers. The fibers were pumped into the tank containing the chemicals and the means of agitation was manual. Therefore, the contact between the fibers and the chemicals in the pilot plant was not nearly in proportion to that contact allowed by mechanical means in the laboratory.

The effect of the contact time between fibers and chemicals

plays a big part in ink separation, conglomeration, and dispersing the particles. The ink particles in the laboratory were small and well dispersed in the stock. The ink conglomerates in the pilot plant trial were very large in comparison. This could be due to the fact that the paper was hydropulped at 130°F without the aid of the basic pH the chemicals offer. Another possibility is that the temperature melted the wax and the ink together, and the chemicals were not present to disperse them in the stock as fine particles. Finely dispersed ink particles are more favorably removed than large ink particles in a flotation deinking system.

CONCLUSIONS

I conclude that the flotation deinking process used in the laboratory with the Voith Morden Deinking Cell is the optimum process to recycle one-time carbon snap out forms at this time. Furthermore, I feel that sodium silicate, potassium soap, caustic, and Triton X-100 are a good combination of chemicals to deink these forms. I am confident that further work would show the percentage chemical addition could be lowered with the same degree of ink removal found in trial thirteen. I also feel that this process could be implemented in an industrial application if the laboratory procedure used could be duplicated industrially.

RECOMMENDATIONS

I recommend any further work attempting to deink one-time carbon snap out forms be directed to the flotation deinking method. I suggest that the basis for deinking should be the chemical makeup of trial thirteen. One could proceed by reducing usage of one variable at a time by the following method. Reduce chemical addition of one variable by one half each trial. Compare the results to the original trial to determine whether more or less chemical is needed. If less chemical is needed, add an amount half the distance to the previous trial. Repeat these steps until the minimal amount of chemical is found, then work on the next variable in the same manner. This would be the most logical approach to finding the minimal amount of chemicals necessary to efficiently deink these carbon snap out forms. Although the trial I ran using the double collector was unsuccessful, I think this area should be given more consideration in the flotation deinking process.

LITERATURE CITED

Bender, Douglas E., Optimization Process For Recycling One-Time Carbon Snap Out Forms. Thesis Paper, Fall Semester, 1978.

Stephenson, J. Newell, Pulp and Paper Manufacture- Volume 3,
"Manufacture and Testing of Paper and Board". McGraw-Hill Book
Company, Inc., 1953.

APPENDIX I

Subject: Tapoi wax extraction method.

Calculations of wax content:

weight of wax and beaker #1	157.591g	beaker #2	154.317g
weight of beaker #1	157.470g	beaker #2	154.205g
weight of wax paper #1	<u>.121g</u>	paper #2	<u>.112g</u>
weight of O.D. paper #1	.513g	paper #2	.506g
weight of extracted paper #1	.309g	paper #2	.391g

weight of $\frac{100 \times \text{weight of wax}}{\text{weight of wax} + \text{weight of paper extract}}$

paper #1) $\frac{100 \times .121}{.121 + .390} = 23.7\% \text{ wax}$

paper #2) $\frac{100 \times .112}{.112 + .391} = 22.3\% \text{ wax}$

average = $\frac{23.7 + 22.3}{2} = 23.0\% \text{ wax in carbon paper}$

Determination of % carbon paper in carbon forms:

paper weight = 25.15g O.D. 6.86 x 100 = 21.4%
carbon forms = 6.86g O.D. $\frac{6.86}{25.15 + 6.86}$

Therefore, the wax present in the carbon forms is:

$(23\%) \times (21.4\%) = 4.92\% \text{ by weight}$

APPENDIX II

Pilot plant trial utilizing cyclone cleaners:

125 lbs. stock beaten in hydrapulver
3% consistency in hydrapulver
pH adjusted to a value of 10.1 with caustic
agitated for 10 minutes

half the slurry was stored in two seperate chests:

chest #1- diluted to .52%; target was 0.50%
chest #2- diluted to .96%; target was 1.0%

chest #1- adjusted pH to 10.2 with caustic
temperature raised to 113°F with steam pipe

chest #2- adjusted pH to 9.6; target 10.0
temperature raised to 113°F

chest #1- feeds Bergstroms and Bird Tricleams

chest #2- fed the Albias

APPENDIX III

Pilot Plant- Voith Morden Deinking Cell:

Constituents:	<u>Dry</u>	<u>Wet</u>
Paper	20 lbs.	9670g
Sodium Silicate	252g	664g
Caustic	176.5g	208g
Potassium Soap	202g	917g
Triton X-100	30.3g	30.3g
		<u>11,489g</u>

+ 9.0 gallons

~~10 gal~~ 6 gal

4% consistency cook, 130°F

.6% consistency in flotation cell

pH 10.4

$$\frac{125 \text{ lbs}}{(.05) (8.35 \text{ lbs/gal})} = 299.4 \text{ gallons of water in hydropulper to achieve 5\% consistency}$$

$$\frac{20 \text{ lbs}}{(.05) (8.35 \text{ lbs/gal})} = 48 \text{ gallons at 5.0\% consistency}$$

$$\frac{20 \text{ lbs}}{(.04) (8.5 \text{ lbs/gal})} = 58.8 \text{ gal.} \approx 60 \text{ gallons for 4\% consistency}$$

60-48 = 12 gallons for chemicals to be mixed in

$$\frac{11.489 \text{ g} = 25.3 \text{ lbs}}{454 \text{ g/lb}} \quad \frac{(25.3 \text{ lbs} + X \text{ lbs water})}{8.5 \text{ lbs/gal}} = 12 \text{ gal.}$$
 $X = 12 \text{ gal.} (8.5) - 25.3$

$$X = \frac{76.7 \text{ lbs. water}}{8.34} = 9.2 \approx 9.0 \text{ gallons water to dilute chemicals}$$

APPENDIX IV

Potassium soap chemical makeup:

180g of Oleic acid (95%)
20g of Stearic acid
150g of Ethanol (95%)
42g of Potassium hydroxide
500g of water

This mixture was produced over a steam bath to encourage solubility of the soap.

TABLE I

COOK	PAPER (g)		Sodium Silicate (g)		Potassium Soap (g)		CAUSTIC (g)		TRITON(g)		(g)	%	PH	%	YIELD	BRTNS
	WET	DRY	WET	DRY	WET	DRY	WET	DRY	TYPE	ACTUAL						
* # 1	128	120	37	14	11.2	5.6	4.0	3.4	CF-10	2.8	2817	17.7				44.1
# 2	95.7	90	20	7.6	9.5	2.1	3.0	2.6	CF-10	2.1	2120	13.4				44.4
# 3	95.7	90	6.6	2.5	9.5	2.1	3.0	2.6	CF-10	2.1	2133	9.4				
# 4	95.7	90			8.2	1.8	2.1	1.8			2144	3.8				
# 5	95.7	90	7.9	3.0	3.6	0.8	4.2	3.6			2138	7.6	11.9			43.4
# 6	95.7	90			8.2	1.8	3.0	2.55			2143	4.6	12.1	91		42.3
# 7	95.7	90	7.1	2.7	2.0	.45			CF-10	1.2	2144	4.6				
# 8	95.7	90	27.8	10.5	12.7	2.8	3.1	3.0	CF-10	2.1	2136	17	12.4	90		46.2
# 9	95.7	90	13.2	5.0	9.5	2.1	3.1	3.0	X-100	2.1	2126	12	12.2			
# 10	95.7	90	7.9	3.0	9.5	2.1	3.0	2.55	X-100	1.5	2140	9.1	10.8	90.8		44.2
# 11	95.7	90	6.6	2.5	9.1	2.0	2.0	1.75	X-100	1.0	2136	7.5	10.3	94.2		46.4
# 12	95.7	90	6.6	2.5	9.1	2.0	1.0	.85	X-100	.2	2137	5.8	9.4	91.7		44.8
# 13	95.7	90	6.6	2.5	9.1	2.0	2.0	1.75	X-100	.3	2137	7.1	10.2	91.6		46.2
* # 14	95.7	90	6.6	2.5	9.1	2.0	2.0	1.75	X-100	.3	2134	8.7	11.0	90.6		46.1
** # 15	95.7	90	6.6	2.5	9.1	2.0	2.0	1.75	X-100	.3	2134	8.7	9.7	89.6		46.1
# 16	95.7	90	6.6	2.5	9.1	2.0	2.0	1.75	X-100	.2	2136	6.7	10.3	90.7		46.1

* .87% CONSISTENCY IN FLOTATION CELL

** 2.0% sodium PEROXIDE ADDED

*** 7.0% Toluene added

TABLE II

COOK	pH	% YIELD	BRTNS	COMMENTS
#1			44.1	ink finely dispersed in handsheets, good foaming and scumming
#2			44.4	good ink removal, ink conglomerates not as visible as first trial
#3				no results - ink plated out in beaker
#4				no results - fibrous mat floated to surface
#5	11.9		43.4	small ink particles, not much foaming, fiber floated \Rightarrow high fiber loss
#6	12.1	91		large ink conglomerates, not adequate scumming or foaming
#7				no results - fibrous mat floated to surface
#8	12.4	90	46.2	very good ink separation, good foaming and scumming, small ink particles
#9	12.2			fibrous mat formed at surface, too much foaming
#10	10.8	90.8	44.2	good scumming, foam better controlled than #9, groundwood fibers present
#11	10.3	94.2	46.4	best ink and fiber separation thus far, excellent yield
#12	9.4	91.7	44.8	ink particles not as well dispersed as #11, handsheets show ink readily
#13	10.2	91.6	46.2	very good ink removal, good foaming and scumming
#14	11.0	90.6	45.5	good ink separation, ink conglomerates larger than in #13
#15	9.7	89.6	46.1	ink particles very large, show up in handsheets this way
#16	10.3	90.7	45.9	good ink separation, good foaming, ink finely dispersed in handsheets