STATUS REPORT: RECLAIMED FIBER UTILIZATION

Project 2697-3 -- Optimization of Recycled Fiber in Linerboard

The first phase of the project is concerned with the addition of composite old corrugated to linerboard. The initial phases of the work involved procurement of equipment, supplies of virgin pulp and the characterization of the fiber supplies. This phase has been completed and the results were reviewed in the January and April status reports. At the July meeting, research in progress on the following subjects was reviewed.

1. Effect of ozonation on recycled fiber properties
2. Effect of distribution and amount
3. Refining variables and techniques

This status report summarizes the status of current work in the above areas as well as planned work on other chemical treatments and additives.

In addition, it may be noted that the Research Plan covering work on both the FKBG and Institute funded portions of this study has been revised. A copy of the revised plan accompanies this status report. In the revised edition, the specific portions of the research to be supported by Institute funding are outlined in a separate part of the plan. The revised cost and time schedules also reflect the current lower rate of expenditures by FKBG and IPC projected into the future.

Effect of Ozonation on Recycled Fiber Properties

The work reported at the July meeting indicated that the strength properties of repulped old corrugated containers (OCC) can be increased significantly by treatment with ozone without any major reduction in freeness. For example, the burst and tensile properties of handsheets made from OCC increased 35 and 27%, respectively, after the fiber had consumed 2.3% O_3. Freeness reduction was insignificant. Ozone treatment also increased the ring compression strength which is important to box compression strength.

The observed strength improvements result from increased fiber-to-fiber bonding in the sheet. Scanning electron micrographs show that ozonation of fibers produces microfibrillation of their surfaces. Micrographs of handsheets formed from these fibers exhibit increased fiber-to-fiber contact and conformability as compared to untreated fibers. Preliminary cost figures on the process appear encouraging.

This research was carried out under Institute funding. A report discussing the above results will be distributed in October. Arrangements have also been made to present a paper on ozonation at the TAPPI Secondary Fiber Conference in New Orleans, November 6-8.

Research on the following topics is underway or is being planned:

1. Effect of ozonation on the liner and medium fractions of old corrugated and blends of the treated and untreated fractions.

   This study will provide information on the advantages and disadvantages of treating only the liner or medium fraction as compared to treatment of the composite OCC.

2. Effect of ozonation on commercially cleaned OCC.

   A question has been raised relative to the effect of contaminants in commercially cleaned and screened OCC on ozonation efficiency. To obtain initial information on contaminant effects, supplies of OCC have been obtained from a local plant after cleaning. Samples were obtained before and after the asphalt dispersion equipment. These samples are being preprocessed preparatory to ozonation.

3. Process improvements to lower O_3 consumption.

   In order to obtain greater strength improvements at lower O_3 consumptions, the laboratory ozonation process has been modified. The initial trials are in progress and appear favorable based on visual examination of the processed pulps.

4. Other chemical treatments.

   Trials are being initiated using caustic treatments, and other treatments will also be studied.

Effect of Distribution and Amount

The work in this phase was summarized in the April and July status reports. No further work is scheduled at present.

Refining Techniques

A preliminary comparison of mixed vs. separate refining is in process using the Sprout-Waldron Twin-flo refiner. This work is being carried out using 40% OCC/virgin blends. The stocks were prepared as follows.

1. Separate refining followed by blending.

   The virgin primary stock was subjected to three passes through the refiner holding the net power/pass to about 1.7 HP day/ton.

The C.S. freenesses of the stock were 730, 675 and 570 cc after the first, second and third passes, respectively, as shown in Table I.

The OCC was pulped in the hydropulper giving a freeness of 635 cc (see Run 50 in Table I). It was then subjected to two passes through the refiner. The resulting freenesses were 530 and 310 cc. The net power on each pass was about 0.3 HP day/ton.

Samples were obtained from each stock after each refining pass. Blends of the refined virgin primary and OCC stocks were then prepared and evaluated as shown in Table II. Figure 1 shows that at constant virgin freeness the freeness of the virgin/OCC blends decreases appreciably as the OCC is refined down to 310 cc Canadian Standard. The bursting strength results show that various blend combinations could be used to obtain burst factors equivalent to the virgin primary but generally at a sacrifice in freeness.

2. Mixed refining

The blends of virgin kraft and OCC were combined prior to refining. Stocks were refined using approximate net energy inputs of 1.3, 2.0 and 2.6 HP day/ton (see Table III). At each net energy input, three passes were made through the refiner and stock samples were taken after each pass.

At a constant freeness, the bursting strength results obtained on the 40% OCC/virgin blends refined together were slightly lower than obtained in the samples which were refined separately and then blended (Figure 2). However, the differences were not great and may not be significant in view of the variability involved. It appears that additional refining trials and other data (e.g., fiber classifi-

TABLE I

CHARACTERISTICS OF REFINED VIRGIN PRIMARY AND OCC STOCKS

Furnish	Run	Pass No.	C.S. Freeness, cc	Cumulative Refining Energy, HP day/ton: Total	Cumulative Refining Energy, HP day/ton: Net	Basis Weight, lb/M ft^2	Caliper mil	App. Density	Burst Factor	Mod. Ring Factor	Tensile Factor	Reg. Ring Factor
Virgin primary	46	1	730	10.0	1.7	41.7	16.8	2.48	2.30	.391	1.10	.296
	47	2	675	20.1	3.5	40.7	14.2	2.87	3.11	.460	1.46	.398
	48	3	570	30.4	5.7	40.7	13.3	3.07	3.38	.467	1.56	.423
OCC	50	1	635[a]	---	---	41.0[a]	15.1[a]	2.71[a]	2.36[a]	.436[a]	1.18[a]	.347[a]
	51	2	530	6.9	0.3	41.0	13.4	3.07	2.90	.492	1.36	.425
	52	3	310	13.9	0.8	41.1	12.5	3.29	3.02	.533	1.57	.505

[a]Stock characteristics after hydropulping.

NOTE: Net power equals total minus idle power.

TABLE II

CHARACTERISTICS OF SEPARATELY REFINED BLENDS OF VIRGIN PRIMARY AND OCC

Run Comb.	Freeness of Base Stocks, cc		Blended Freeness, cc	Cumulative Refining Energy, HP day/ton		Basis Weight, lb/M ft²	Caliper, mil	App. Density	Burst Factor	Mod. Ring Factor	Tensile Factor	Reg. Ring Factor
	Virgin Primary	OCC		Total[a]	Net[a]							
46/50	730	635	700	6.0	1.0	41.9	16.8	2.49	2.19	.416	1.10	.306
47/50	675	635	660	12.0	2.1	41.2	15.3	2.69	2.56	.416	1.20	.352
48/50	570	635	590	18.2	3.4	39.8	14.3	2.78	2.97	.465	1.43	.390
46/51	730	530	680	8.8	1.1	39.9	14.8	2.69	2.62	.440	1.18	.348
47/51	675	530	630	14.8	2.2	42.9	14.9	2.87	2.86	.461	1.21	.395
48/51	570	530	550	21.0	3.5	40.2	13.3	3.02	3.03	.491	1.43	.428
46/52	730	310	635	11.6	1.3	40.9	14.9	2.75	2.81	.450	1.28	.369
47/52	675	310	550	17.6	2.4	39.4	12.6	3.13	3.20	.486	1.40	.427
48/52	570	310	490	23.8	3.7	40.6	12.8	3.17	3.23	.511	1.54	.449

[a]Calculated from refining energies of base stocks (Table I).

NOTE: 40% OCC, 60% virgin primary

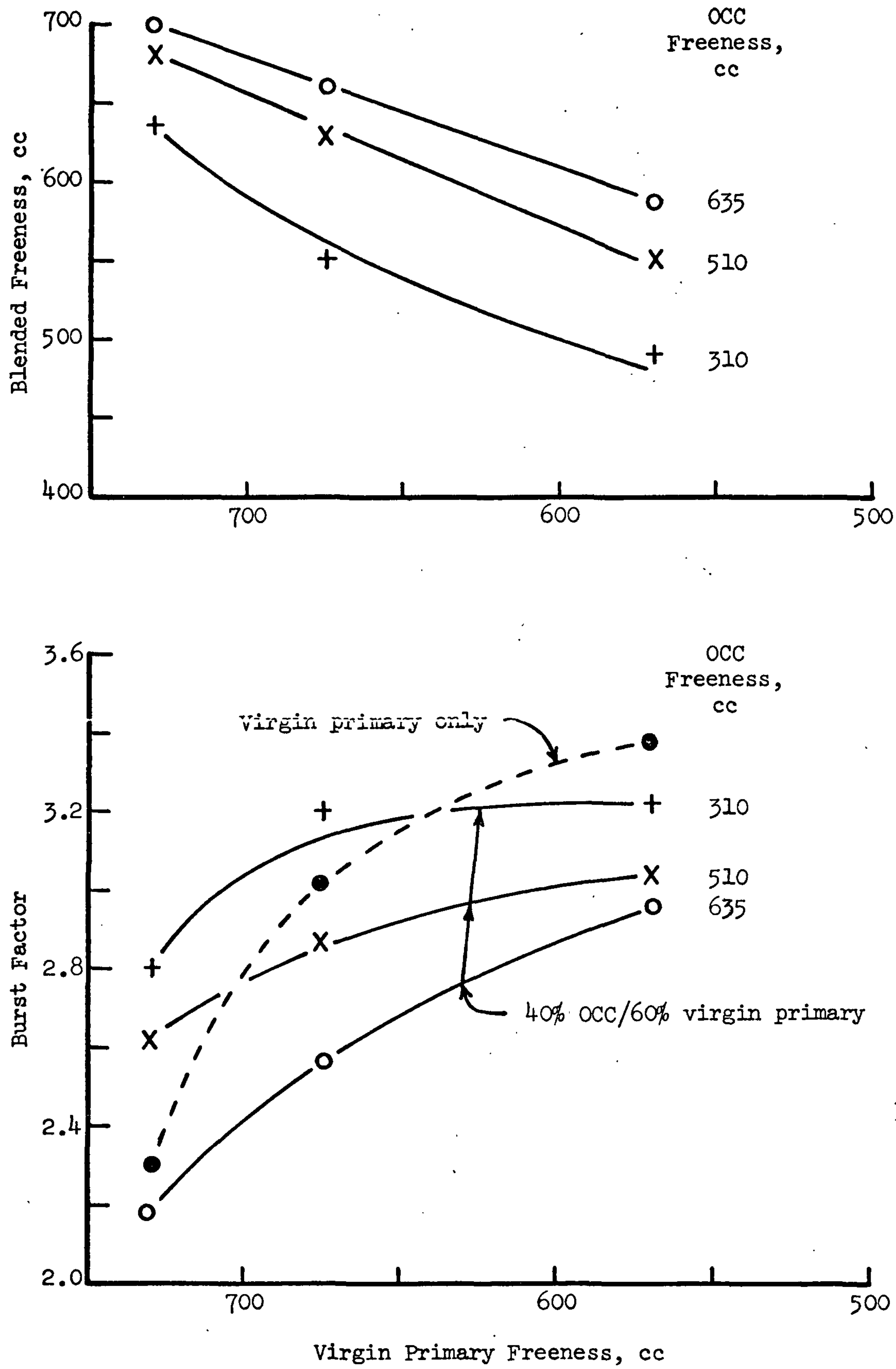

Figure 1. Burst and freeness results on separately refined and blended virgin primary and OCC

TABLE III

CHARACTERISTICS OF BLENDS OF VIRGIN PRIMARY AND OCC STOCKS REFINED TOGETHER

Run	Pass No.	Freeness, cc	Cumulative Refining Energy, HP day/ton		Basis Weight, lb/M ft^2	Caliper, mil	App. Density	Burst Factor	Mod. Ring Factor	Tensile Factor	Reg. Ring Factor
			Total	Net							
25	1	685	9.3	1.3	46.2	16.9	2.73	2.44	.432	1.19	.361
26	2	640	18.6	2.4	44.9	15.4	2.91	2.67	.452	1.25	.386
27	3	590	27.9	3.9	42.3	14.0	3.03	2.94	.478	1.41	.425
28	1	670	10.4	2.0	---	---	---	---	---	---	---
29	2	615	20.8	4.2	44.2	15.7	2.81	2.76	.481	1.18	.425
30	3	530	31.0	6.6	42.8	14.5	2.96	2.96	.513	1.34	.456
40	1	660	11.2	2.6	40.6	15.3	2.65	2.52	.467	1.23	.377
41	2	515	22.3	5.6	39.9	13.5	2.95	3.12	.484	1.43	.448
42	3	355	33.5	8.8	40.8	12.0	3.40	3.62	.533	1.71	.492

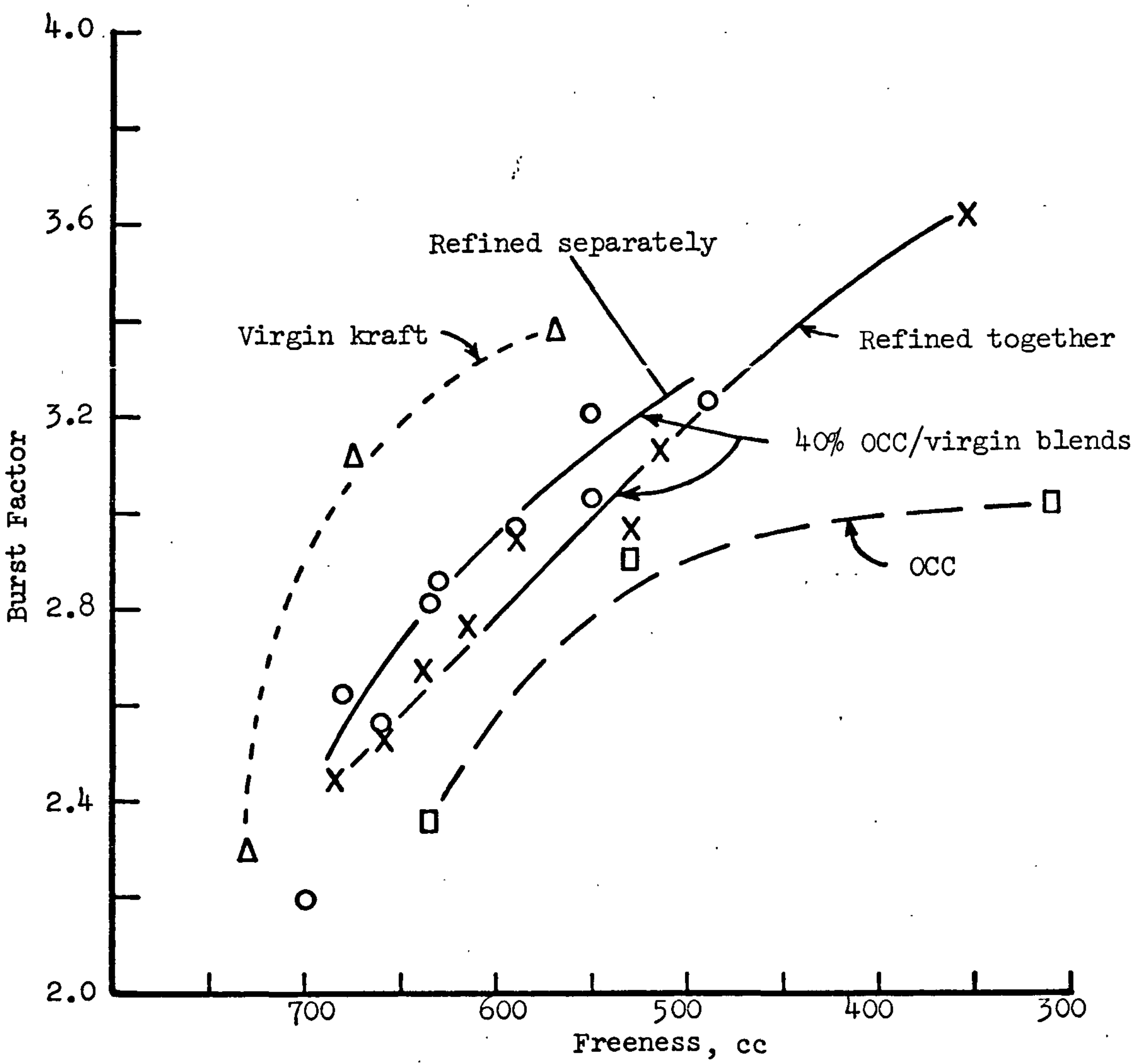

Figure 2. Comparison of mixed vs. separate refining on the bursting strength of 40% OCC/virgin blends

cation) will be required to better define the nature and extent of the strength differences due to mixed vs. separate refining. This may also involve consideration of other refining variables such as plate pattern and consistency in an effort to develop greater strength with less freeness reduction.

At constant freeness the regular ring compression results for the blends refined together were slightly higher than obtained on the samples which were refined separately (Figure 3). This trend is opposite to that obtained for bursting strength, which may be a reflection of the differences in response of the fiber and fiber-to-fiber bonds to compressive and tensile stresses. As in the case of bursting strength, the differences in ring compression between mixed and separate refining were not very large and additional work will be required to confirm the results.

Figure 4 shows the bursting strength results for the mixed and separately refined blends as a function of the net refining power. The results suggest that less net power may be required in the case of separate refining than mixed refining, somewhat depending on the way the virgin and OCC stocks are separately refined. Further work to investigate the possible power savings involved should be of interest.

Chemical Additives and Treatments

Work on other chemical treatments is being started. This will make it possible to compare the effectiveness and costs of other treatments. Treatments with caustic to increase swelling and enhance bonding will be studied first.

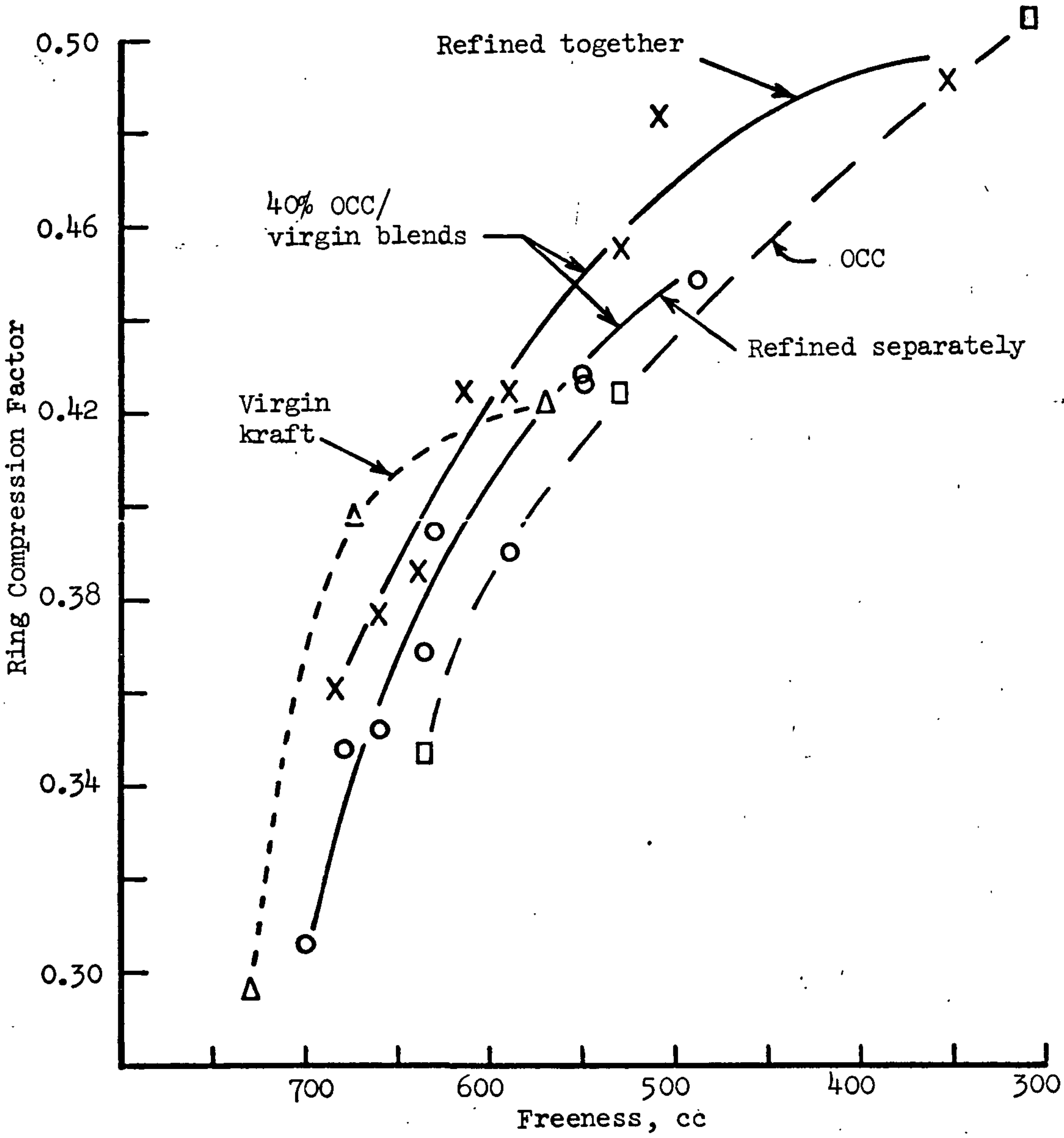

Figure 3. Comparison of mixed vs. separate refining on the ring compression factor of 40% OCC/virgin blends

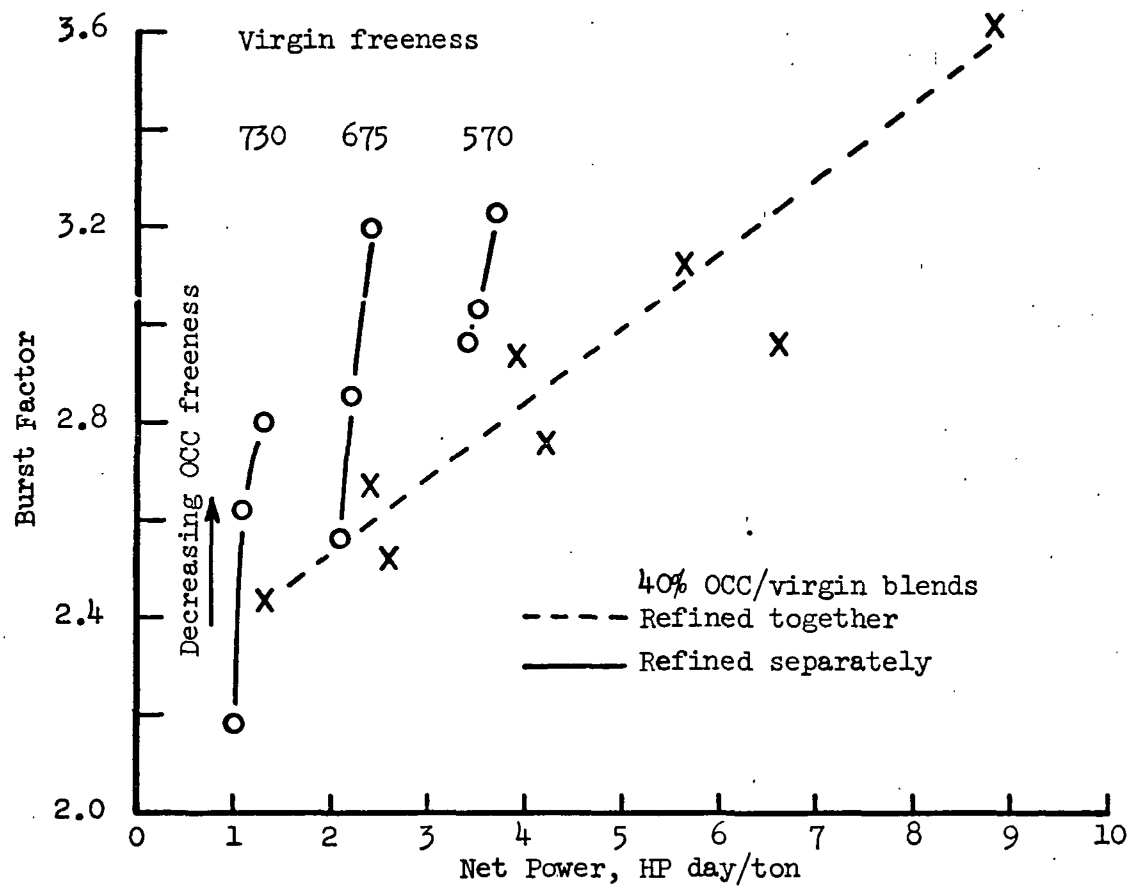

Figure 4. Burst vs. net refining power

In the chemical additive area it is planned to study the use of selected bonding and production aids to achieve acceptable strength and water-removal properties. The initial materials to be studied will include cationic corn starch, cationic potato starch, guar or locust bean gum and synthetic drainage aids.