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MEMORANDUM REPORT NO. M-677

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A STUDY OF THE FACTORS AFFECTING THE ABRASION RESISTANCE OF THE 711 LINE PRODUCTS

INTRODUCTION

This report covers information that is basic to the development of maximum properties in our abrasion resistance finishes.

Previous work had indicated that increasing the pigment content has an adversely affected abrasion resistance. To allow a more concise study of this effect, Wilmington issued investigation WI-2514.

CONCLUSION

The results of our work can be summarized as follows:

1) Low pigment-to-binder products should be used if the maximum abrasion resistance is desired.

2) The addition of 50% polythene on the pigment is all that is necessary to give the desired improvement in abrasion resistance. This level of polythene also gives the best gloss.

It is our opinion that since the abrasion resistance of a finish is primarily a surface effect, the information developed in this study will apply to all types of baking enamels.

EXPERIMENTAL DETAILS

A latin square was designed with three variables each at four levels:

P/B Ratio	= 40/100	60/100	80/100	100/100
% Polythene	= 0.0%	5.0%	7.5%	10%
Alkyd-UF Ratio	= 40/60	50/50	60/40	70/30

Each finish was checked for abrasion resistance, gloss and hardness. For this study, the Tabor Abrasion value, the 22° Aminco-Scott, and Knoop Hardness values were used.

Abrasion Resistance

Since the high P/B product without polythene wore through to the substrate after 800 cycles, our evaluation was based on the weight loss after 500 cycles. The results show that abrasion resistance is significantly effected by both the addition of polythene and variation in P/B ratio.

The use of 5.0% polythene caused as marked improvements in the abrasion resistance but additional amounts, 7.5% and 10.0%, did not make any significant change in this property. This improvement was noted at all the P/B ratios studied.

Each of the P/B ratios studied resulted in a change in the abrasion resistance. As the P/B ratio is increased, at constant polythene content and alkyd-UF ratio, we have a decrease in abrasion resistance.

Gloss

Each of the three variables studied significantly affected the gloss. A study of the data shows that increasing the polythene content the P/B ratio and the alkyd-UF ratio all tend to decrease the gloss.

Hardness

As expected, only the alkyd-UF ratio had a marked effect on the hardness of the system. Each of the four levels studied was significantly different - the greater the UF content the harder the finish.

The numerical values are given on the attached tables. The data can be found in notebook 5686, pages 78 to 87.

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Attach.

REFERENCES

Philadelphia Laboratory Research Report No. 863
" " " " " 906
" " " " " 953

Investigation CL-I-304-52
CL-I-376-52

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TABLE I

* The values given are the average of three.

POLYTHENE CONTENT (% ON PIGMENT)

		0.0%	5.0%	7.5%	10.0%	Avg.
		A	B	C	D	
40/100	Taber Abrasion	36.2*	22.5	17.5	22.9	24.7
	22° Aminco-Scott	53.4	44.1	47.4	46.3	47.8
	Tukon Hardness	13.9	11.9	8.2	5.4	9.8
		B	C	D	A	
P/B 60/100	Tabor Abrasion	41.1	22.4	22.8	19.9	26.6
	22° Aminco-Scott	54.0	38.4	34.8	14.0	35.3
	Tukon Hardness	11.9	8.9	5.7	13.2	9.9
		C	D	A	B	
Ratio 80/100	Taber Abrasion	49.2	27.3	23.6	24.0	31.0
	22° Aminco-Scott	53.1	26.0	12.2	7.8	24.8
	Tukon Hardness	8.2	5.5	13.2	11.9	9.7
		D	A	B	C	
100/100	Taber Abrasion	49.1	30.7	31.5	34.3	36.4
	22° Aminco-Scott	54.6	18.4	9.6	7.1	22.4
	Tukon Hardness	5.6	13.6	12.2	9.5	10.2
	Tabor Abrasion	43.9	25.7	23.8	25.3	
Average	22° Aminco-Scott	53.8	31.7	26.1	18.8	
	Tukon-Hardness	9.9	10.0	9.8	10.0	

	Average		
Alkyd-UF Ratio	Tabor Abrasion	22° Aminco-Scott	Tabor Hardness
A = 40/60	27.6	24.5	13.5
B = 50/50	29.8	28.9	12.0
C = 60/40	30.8	36.5	8.7
D = 70/30	30.5	40.4	5.5

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TABLE II

ABRASION RESISTANCE

Source of Variance	Sum of Squares	Degrees of Freedom	Mean Square	Variance Test Ratio
P/B ratio	966.7	3	322.3	28.6
Polythene Level	3260.3	3	1086.8	96.4
Alkyd-UF Ratio	85.1	3	28.4	2.5
Residual	428.4	38	11.3	
Total	4740.5	47		

At these degrees of freedom, the variance test ratio to be significant at 50% level must be greater than 2.9.

The difference between two averages at the 95% level is 4.8.

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TABLE III

GLOSS

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	Variance Test Ratio
P/B Ratio	3	4840.2	1613.4	83.2
Polythene level	3	8193.3	2731.1	141.8
Alkyd-UF Ratio	3	1880.7	626.9	32.3
Residual	38	739.0	19.4	
Total	47	15653.2		

The difference between two averages to be significant at the 95% level must be in excess of 6.2 units.

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TABLE IV

HARDNESS

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Square	Variance Test Ratio
P/B Ratio	3	1.8	0.6	1.2
Polythene Level	3	0.2	0.07	0.1
Alkyd-UF Ratio	3	448.2	182.7	365.4
Residual	39	18.2	0.5	
Total	47	468.4		

The difference between two averages to be significant at the 95% level must be in excess of 1.2 units.

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