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TECHNICAL REPORT
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July 12, 1968

EVALUATION OF UNION CARBIDE'S RESIN GRADE 244 ASBESTOS FOR POLYESTER RESIN

for

CAB-O-SIL

GENERAL TECHNICAL SERVICE

by
GEORGE H. PELLETT

submitted to
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INTEROFFICE CORRESPONDENCE

CABOT CORPORATION

BILLERICA RESEARCH CENTER

CONCORD ROAD, BILLERICA, MASSACHUSETTS 01821

To: D. P. Kintz
From: G. H. Pellett

DATE July 12, 1968

SUBJECT: EVALUATION OF UNION CARBIDE'S RESIN GRADE 244 ASBESTOS FOR POLYESTER RESIN

ABSTRACT

Resin Grade Asbestos 244 was compared to CAB-O-SIL in unpromoted and promoted polyester resin. In the unpromoted resin, the asbestos material was as efficient at equal weight as CAB-O-SIL EH-5. However, an extreme sensitivity of the asbestos to promoted resin was shown by a large viscosity loss upon addition of Cobalt to the resin.

A nonionic additive was considerably effective for increasing CAB-O-SIL thickening efficiency in both promoted and unpromoted resin, whereas RG-244 showed no response to the additive in the promoted system.

In addition, lot-to-lot variability of the asbestos material was indicated by a considerable difference in thickening efficiency between two samples of RG-244. Further, small differences in degree of dispersion were found to affect the performance of the asbestos material; viscosity decreased with increasing time of dispersion shear. This could be an advantage for RG-244 if best efficiency were obtained with minimum processing time. However, this would require extremely careful control of dispersion procedures to insure batch reproducibility.

INTRODUCTION

Resin-Grade Asbestos 244 is a new, modified asbestos fiber developed by Union Carbide for thickening and thixotropy in polyester resin. The purpose of this study was to determine the relative performance of RG-244 to CAB-O-SIL with respect to cost and weight bases for equal performance in Polylite 31-007 a general purpose polyester resin. Other recommended areas of use are plastisols and organosols, adhesives and sealants.

RESULTS AND DISCUSSION

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Samples were dispersed in a Waring Blender at high speed for 5 minutes. The materials evaluated were CAB-O-SIL M-5 (1K037), EH-5 (1E167), and Resin-Grade Asbestos 244 (February lot). The concentrations used were 0.50, 0.75 and 1.00% by weight in Polylite 31-007

lot 7-7-3040. An additive, G2320* was used at 20% (based on the thickener weight). Promoted samples contained 0.5% Cobalt by weight (6% solution).

The data obtained in this study are shown in Table I. Physical properties of RG-244 are shown in Table II.

In unpromoted resin, RG-244 was found to be slightly more efficient in viscosity than CAB-O-SIL EH-5 up to 1% concentration where a greater difference occurred (Graph I). But the Shear Thinning Index (S.T.I.), which indicates the degree of pseudoplasticity was about the same for EH-5 and RG-244 (Graph II). This indicates that EH-5 will yield equal pseudoplasticity at lower viscosity than RG-244 which should result in better wetting of laminates. Once the system is promoted the extreme sensitivity of RG-244 to Cobalt can be seen by the following data taken from Table I. The thickener concentration is 1% by weight.

Thickener	LVT Brookfield Viscosity, cps. 6 rpm	60 rpm	S.T.I.	% Loss 6 rpm	60 rpm	S.T.
EH-5 (unpromoted)	3120	1150	2.7			
EH-5 (promoted)	2880	1066	2.7	8	7	0
RG-244 (unpromoted)	4220	1564	2.7			
RG-244 (promoted)	2760	1280	2.2	35	19	19

Notice that the original pseudoplasticity of EH-5 was retained after promotor addition although some viscosity loss occurred. As the data show, large decreases of viscosity and pseudoplasticity occurred with RG-244.

It is shown in Graphs I and II that the CAB-O-SIL M-5 grade had little effect on resin viscosity and pseudoplasticity. This is probably because this particular lot of resin has little, if any, unreacted glycol present.

In unpromoted resin, both CAB-O-SIL EH-5 and RG-244 responded equally well to the use of the additive G2320. Large increases in viscosity (Graph III) and pseudoplasticity (Graph IV) were observed. Although less significant, CAB-O-SIL M-5 also showed large increases. However, on a percentage basis, CAB-O-SIL M-5 responded much greater to the additive than EH-5 or RG-244. This point deserves further consideration. The CAB-O-SIL M-5 lot used in this study, lot (1k037) was tested in another recent lot of Polylite resin. For comparison, the data obtained with and without the additive G2320 are shown below for both resins.

*Atlas Chemical Co., Polyoxyethylene (20) Sorbitol.

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% CAB-O-SIL M-5	Lot No. Resin	LVT Brookfield Viscosity. cps. 6 rpm	60 rpm	S.T.I.
1%	7-7-3040	660	690	1.0
1% (with additive)	7-7-3040	5200	1617	3.2
1%	7-8-0895	2360	800	2.9
1% (with additive)	7-8-0895	4500	1350	3.3

The point illustrated by this data should support the previous comment as to why CAB-O-SIL M-5 showed little effect in the resin used in this study (lot no. 7-7-3040). Trace amounts of unreacted glycol in the resin apparently largely effect CAB-O-SIL performance. The use of further additive, although significant, is less effective than the initial trace amount present after manufacture. Therefore the differences of CAB-O-SIL performance with some lots of resin is probably accounted for by small variations in the amount of unreacted glycol.

In promoted resin, both CAB-O-SIL EH-5 and M-5 respond to the additive G2320, and EH-5 shows much greater increases of viscosity and pseudoplasticity than M-5. The asbestos material showed no response to the additive at any concentration of RG-244. These data are plotted in Graphs V and VI. According to the Graphs, to obtain a viscosity of 2000 cps. and an S.T.I. of at least 2.0, 0.58% CAB-O-SIL EH-5 and 0.83% RG-244 by weight could be used. At per pound prices of $0.84 for EH-5 and $0.66 for RG-244, the following costs of each material are calculated to thicken a 100 pound batch of polyester resin.

	Weight (lbs.)	Costs	
EH-5	0.58	$0.49	
G-2320	0.12	0.03	$0.52
RG-244	0.83	0.55	

CAB-O-SIL EH-5 results in a significant cost difference or reduction of $0.03. Also, notice in Graph VI that a much greater S.T.I. is attainable with EH-5.

Comparison of the wetting rates of M-5, EH-5, and RG-244 using the laboratory standard wetting test indicate that the asbestos material has much slower wetting rates than CAB-O-SIL at typical spray resin viscosities. This is illustrated by the following data taken from Table I.

Notebook No.	Thickener	LVT Brookfield Viscosity (cps.) 6 rpm	60 rpm	S.T.I.	Wetting Rate (Min.-Sec.)
N992-50 B1	0.50% M-5	1400	708	2.0	2:26
N992-50 B3	0.50% RG-244	1140	672	1.7	7:45
N992-48 1C	0.50% M-5	2100	908	2.3	3:13
N992-48 2C	0.50% EH-5	2880	1158	2.5	10:10
N992-48 3C	0.50% RG-244	2460	918	2.7	18:30

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The lot-to-lot variability of the asbestos material was indicated by data for the samples in Table I identified as N992-70 A-D. This RG-244 lot was received after the first lot used for this study. Notice the viscosity data at 6 rpm for the N992-70 samples is almost 50% less than identical sample preparations using the first RG-244 lot, (samples N992-45 G,-50 B6, -50 AO, -58 3C).

Sensitivity to degree of dispersion of RG-244 is illustrated by samples in Table I identified as N1009-45 A-E. From one to five minutes of dispersion at high speed in the Waring Blender, the viscosity at 2 rpm was reduced from 10,700 to 4100 cps. and the S.T.I. went from 5.3 to 3.2. CAB-O-SIL M-5, on the other hand, (N992-71 A-E) reduced in viscosity only from 3200 to 2760 cps. and the S.T.I. showed no significant change. Of course, optimum efficiency with little dispersion time required must be considered as a favorable point for this asbestos material, but it is also likely that because of this characteristic, batch to batch reproducibility of resin viscosity and pseudoplasticity would be difficult for the user unless processing variables were minimized and dispersion parameters stringently controlled.

All samples prepared in this study were viscosity stable and showed no settling after two months shelf aging.

CONCLUSIONS

Based on the data obtained, the following conslusions are drawn:

1. At the same concentration, CAB-O-SIL M-5 gives equal pseudoplasticity as RG-244 at a lower viscosity level in promoted resin. With an additive, CAB-O-SIL EH-5 is more efficient than M-5 and RG-244 on cost and weight bases for equal performance. In unpromoted resin, with or without an additive, RG-244 is better on a cost basis for equal performance than CAB-O-SIL M-5 and EH-5.

2. Efficiency of CAB-O-SIL M-5 and EH-5 is increased with an additive, G2320, in both promoted and unpromoted polyester resin, but has no effect on performance of RG-244 in promoted resin.

3. CAB-O-SIL exhibits considerably faster wetting rate of fiberglass cloth than RG-244 at typical spray resin viscosity.

4. Significant viscosity and pseudoplasticity differences are apparent between two lots of RG-244 tested in polyester resin. This indicates some inherent variability with this asbestos material.

5. RG-244 obtains optimum efficiency with minimum dispersion time, but processing difficulties with respect to batch-to-batch resin uniformity might be encountered with the asbestos material because of its sensitivity to degree of dispersion.

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FUTURE WORK

This material is being evaluated in other recommended systems and results will be reported upon completion.

George H. Pellett

GHP/b
Attachments (9)

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Union Carbide trial exhibit UC-1023: G. H. Pellett to D. P. Kintz on Evaluating Union Carbide's Resin Grade 244 As...
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TABLE I

Comparison of CAB-O-SIL M-5, CAB-O-SIL EH-5, and RG244 in Polylite 8007 Polyester Resin

Notebook No.	% Thickener	Thickener Grade	Additive Used	Promoter	Brookfield Viscosity, cps. One Day 6 rpm	60 rpm	S.T.I.	Wetting Rate
High Speed Waring Blendor								
Control Resin		-	-	-	400	410	1.0	
992-48 1A	0.50	M-5	-	-	425	447	1.0	1:10
992-48 1C	0.50	M-5	G2320	-	2100	908	2.3	
992-50 B1	0.50	M-5	G2320	Cobalt	1400	708	2.0	3:13
								2:26
992-48 2A	0.50	EH-5	-	-	1000	668	1.5	
992-48 2C	0.50	EH-5	G2320	-	2880	1158	2.5	
992-50 B2	0.50	EH-5	G2320	Cobalt	1940	882	2.2	10:10
								3:42
992-48 3A	0.50	RG244	-	-	1400	700	2.0	
992-48 3C	0.50	RG244	G2320	-	2460	918	2.7	
992-50 B3	0.50	RG244	G2320	Cobalt	1140	672	1.7	18:30
								7:45
992-48 1B	0.75	M-5	-	-	450	493	0.9	
992-48 1D	0.75	M-5	G2320	-	3300	1196	2.8	
992-58 1B	0.75	M-5	G2320	Cobalt	1600	790	2.0	
992-48 2B	0.75	EH-5	-	-	2200	936	2.3	
992-48 2D	0.75	EH-5	G2320	-	4900	1554	3.2	
992-58 2B	0.75	EH-5	G2320	Cobalt	2760	1056	2.6	
992-48 3B	0.75	RG244	-	-	2240	968	2.3	
992-48 3D	0.75	RG244	G2320	-	4580	1370	3.3	
992-58 3B	0.75	RG244	G2320	Cobalt	1660	862	1.9	
992-45 A	1.0	M-5	-	-	660	690	1.0	
992-50 B4	1.0	M-5	-	Cobalt	1760	798	2.2	
992-50 A1	1.0	M-5	G2320	-	5200	1617	3.2	
992-58 1C	1.0	M-5	G2320	Cobalt	2340	1012	2.3	
992-70 A	1.0	RG-244*	-	-	2340	1012	2.3	
992-70 C	1.0	RG-244*	G2320	-	5540	1500	3.7	
992-70 B	1.0	RG-244*	-	Cobalt	1500	846	1.8	
992-70 D	1.0	RG-244*	G2320	Cobalt				

Union Carbide trial exhibit UC-1023: G. H. Pellett to D. P. Kintz on Evaluating Union Carbide's Resin Grade 244 As...
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TABLE I (Cont'd.)

Dispersion Time	Notebook No.	% Thickener	Thickener Grade	Additive Used	Promoter	Brookfield Viscosity, cps. One Day 6 rpm	60 rpm	S.T.I.
	N992-45 C	1.0	EH-5	-	-	3120	1150	2.7
	N992-50 B5	1.0	EH-5	-	Cobalt	2880	1066	2.7
	N992-45 E	1.0	EH-5	G2320	-	9400	2490	4.1
	N992-58 2C	1.0	EH-5	G2320	Cobalt	4380	1390	3.1
	N992-45 G	1.0	RG244	-	-	4220	1564	2.7
	N992-50 B6	1.0	RG244	-	Cobalt	2760	1280	2.2
	N992-50 A0	1.0	RG244	G2320	-	10400	2600	4.0
	N992-58 3C	1.0	RG244	G2320	Cobalt	2740	1202	2.3
	Low Speed - Waring Blendor - Resin Lot 7-8-0895					2 rpm	20 rpm	S.T.I.
(1 min.)	N1009-45 A	1.25	RG244	-	Cobalt	10700	>2000	<5.3
(2 min.)	N1009-45 B	1.25	RG244	-	Cobalt	7200	1900	3.8
(3 min.)	N1009-45 C	1.25	RG244	-	Cobalt	5960	1544	3.8
(4 min.)	N1009-45 D	1.25	RG244	-	Cobalt	4200	1314	3.2
(5 min.)	N1009-45 E	1.25	RG244	-	Cobalt	4100	1260	3.2
(1 min.)	N992-71 A	1.25	M-5	-	Cobalt	3200	758	4.2
(2 min.)	N992-71 B	1.25	M-5	-	Cobalt	2900	692	4.2
(3 min.)	N992-71 C	1.25	M-5	-	Cobalt	2860	675	4.2
(4 min.)	N992-71 D	1.25	M-5	-	Cobalt	2560	630	4.1
(5 min.)	N992-71 E	1.25	M-5	-	Cobalt	2760	660	4.1

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TABLE II

TYPICAL PHYSICAL PROPERTIES *

Specific Gravity, g. per ml	2.45
Moisture Content, % by weight	2.0, maximum
Nature of Surface Charge	Neutral
Refractive Index, h_d 25°C.	1.54 to 1.56
Bulking Value, gallons per 100 lb.	4.8
Dry Bulk Density, lb. per cubic foot	1.0
Standard Package Weight, lb.	10.0

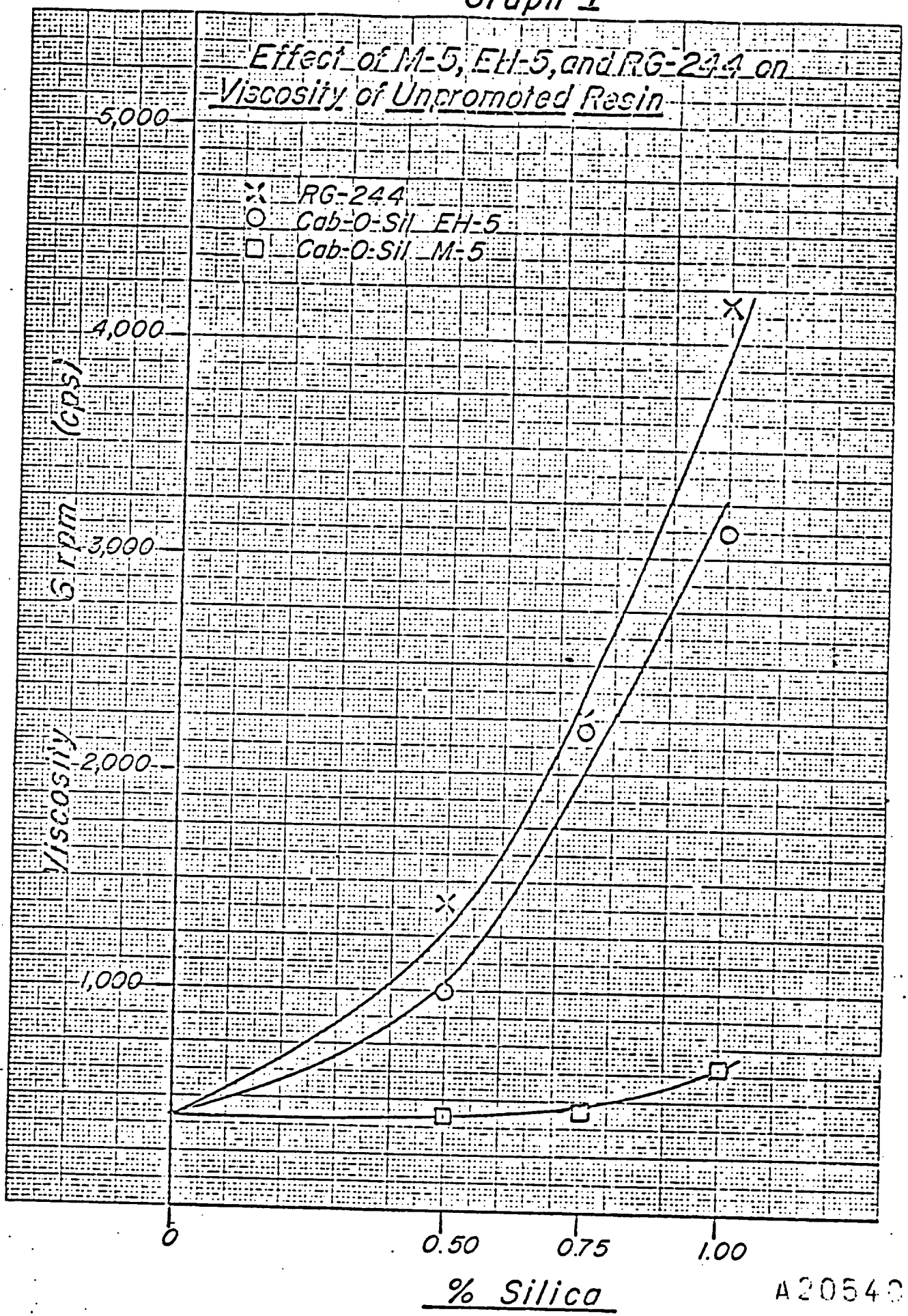
*Quoted from Union Carbide literature.

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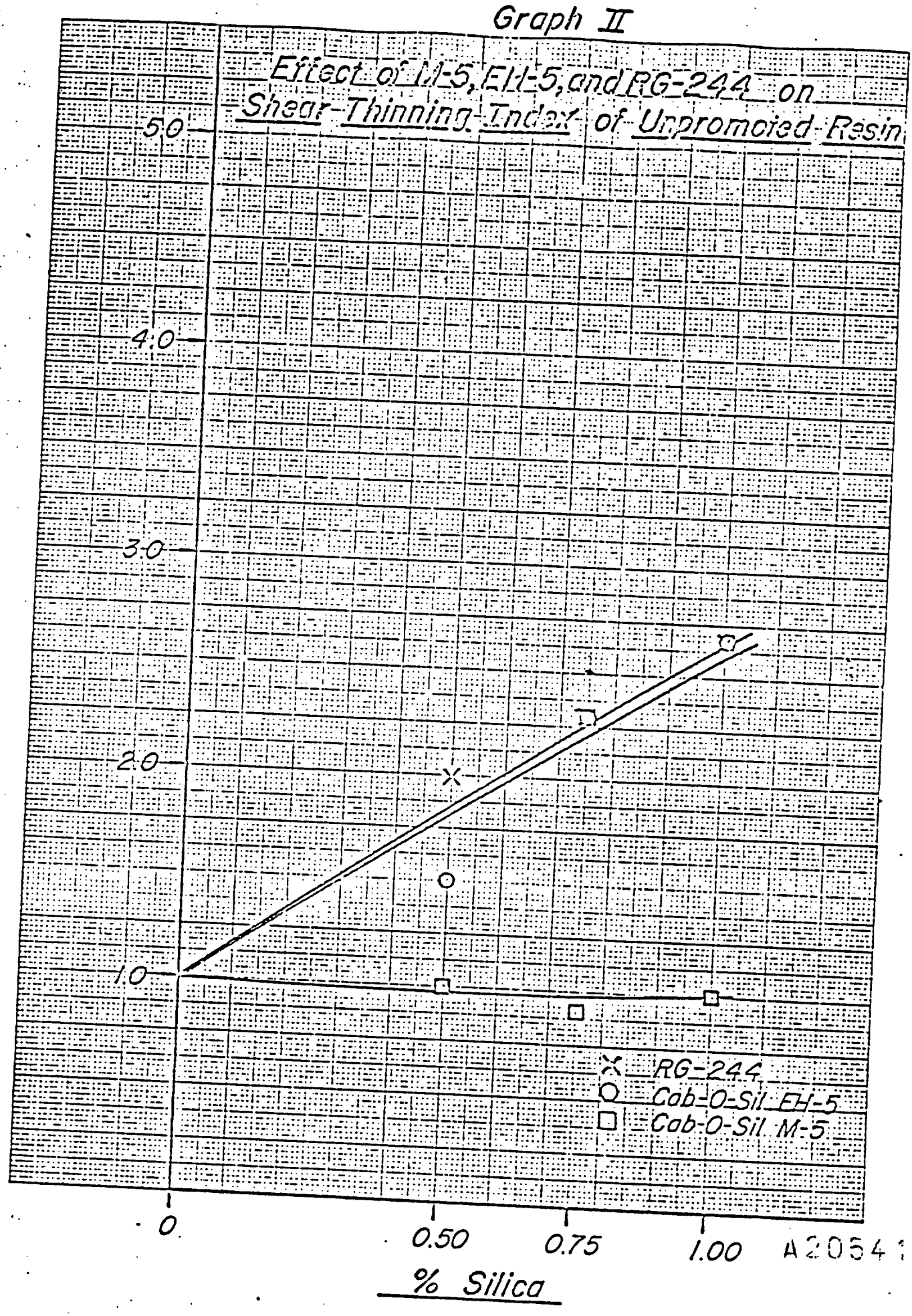
Graph I

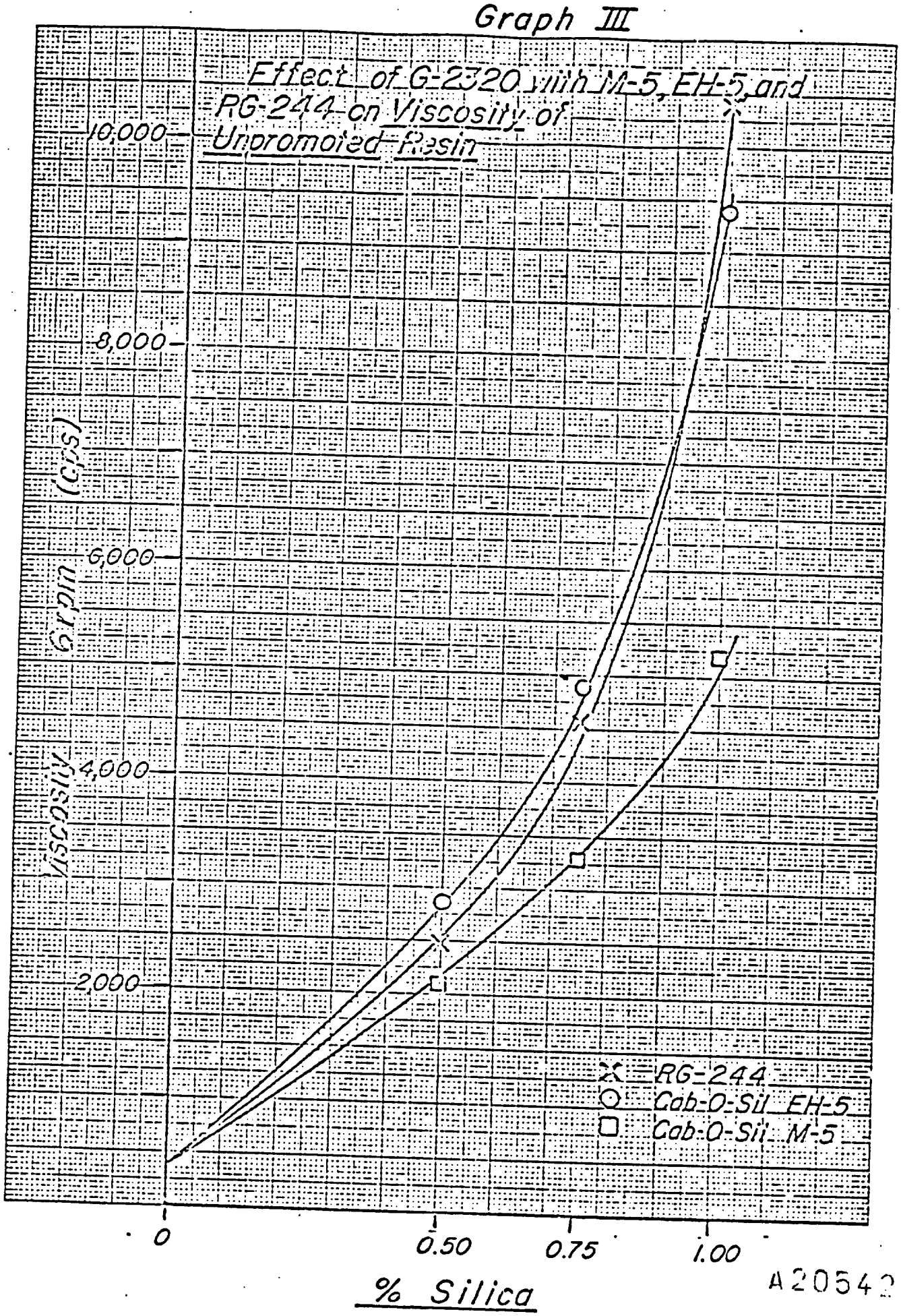
Effect of M-5, EH-5, and RG-244 on Viscosity of Uncromoted Resin



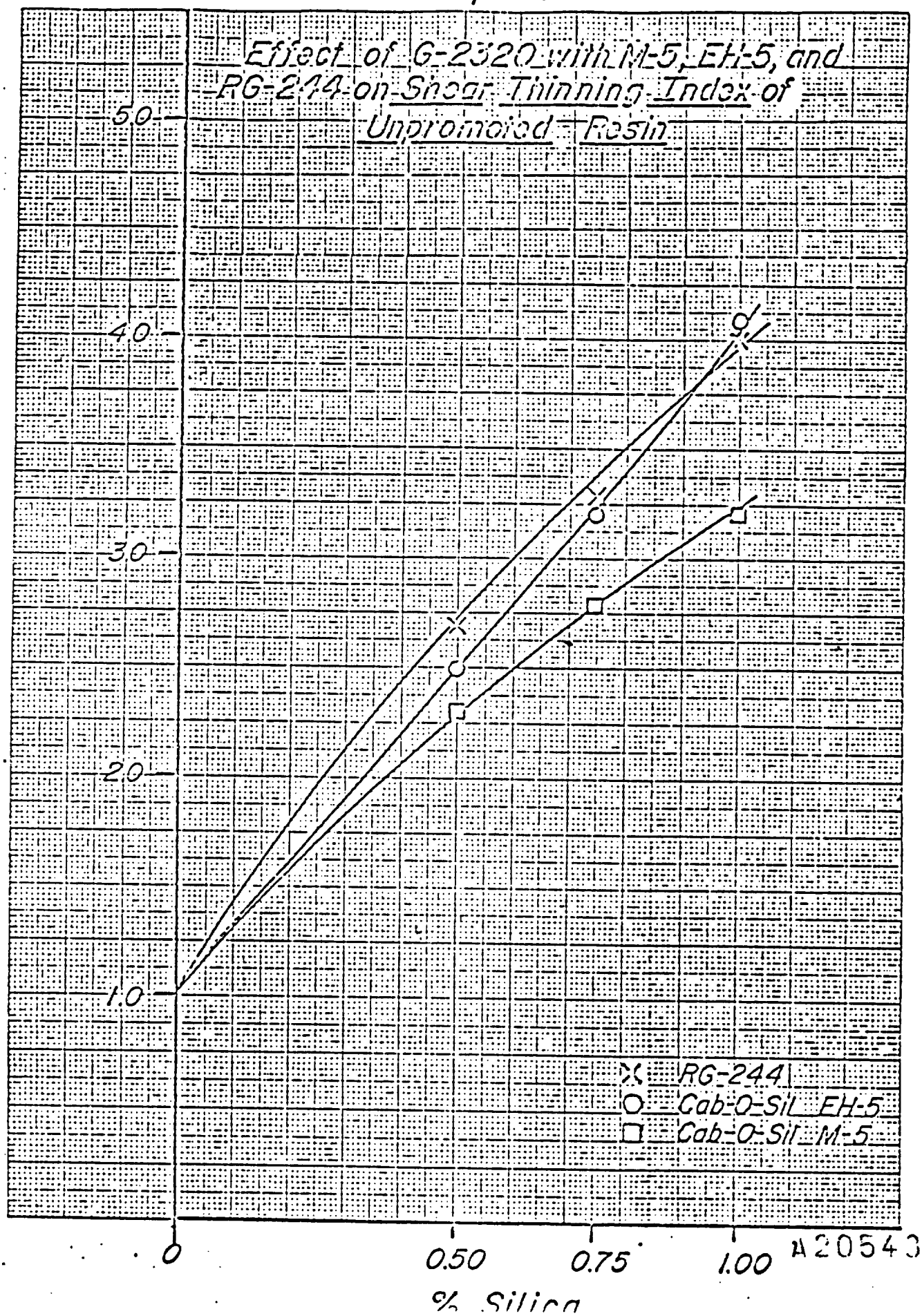
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Graph II
Effect of M-5, EH-5, and RG-244 on
Shear-Thinning Index of Unpromoted Resin
5.0
4.0
3.0
2.0
1.0
0
0.50
0.75
1.00
% Silica
RG-244
Cab-O-Sil EH-5
Cab-O-Sil M-5
A20541


Graph III
Effect of G-2320 with M-5, EH-5 and RG-244 on Viscosity of Unpromoted Resin
10,000
8,000
6,000
4,000
2,000
Viscosity (cps)
0
0.50
0.75
1.00
% Silica
RG-244
Cab-O-Sil EH-5
Cab-O-Sil M-5
A20542

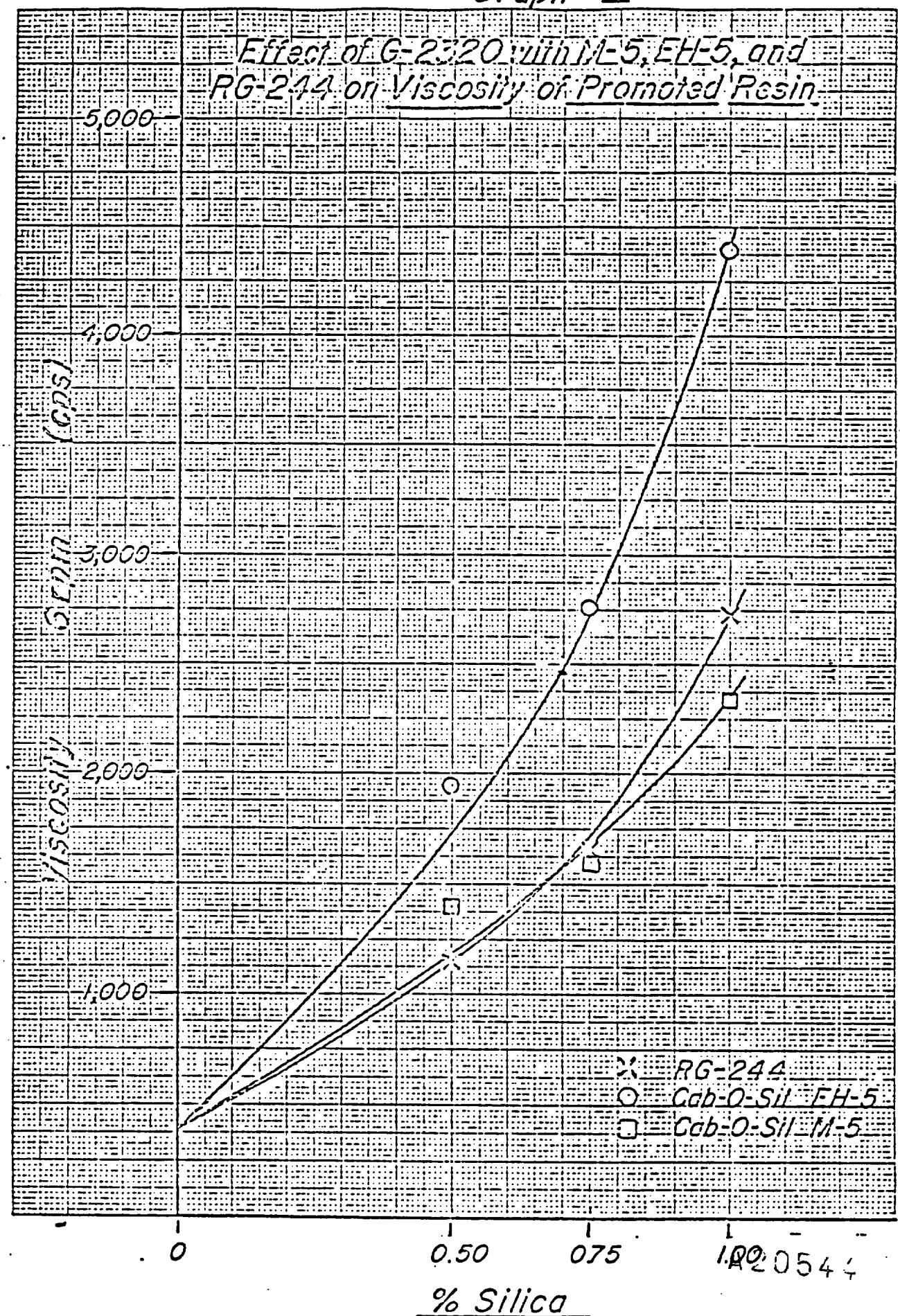
Graph IV



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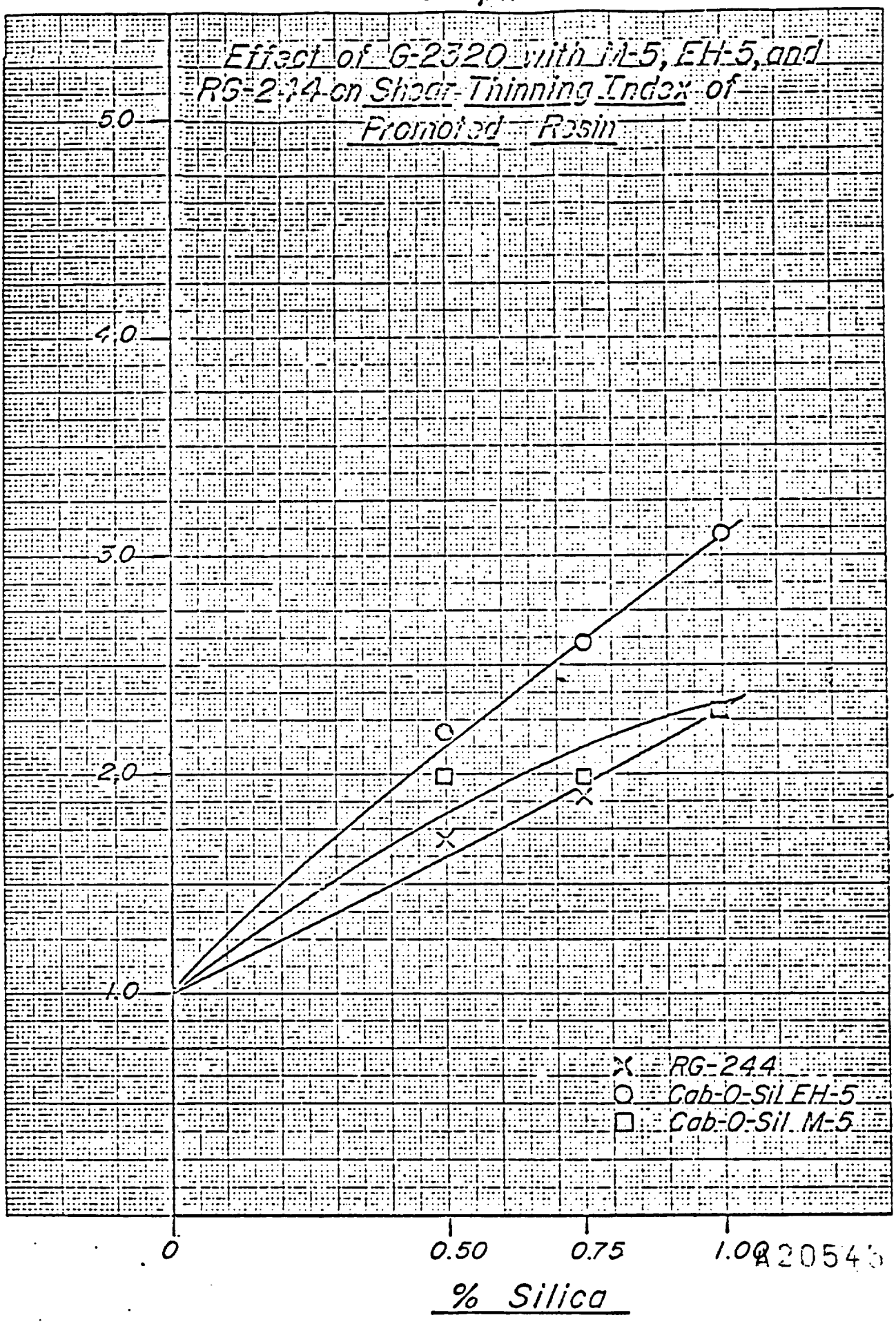
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Graph V



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Graph VI



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