PLAINTIFF'S EXHIBIT
UC-3950

UNION CARBIDE

Calidria ASBESTOS

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CALIDRIA ASBESTOS RG-244 AS A THIXOTROPE FOR POLYESTER RESINS (SPECIAL CONSIDERATIONS)

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ACL Doc 18585 · Page 1 of 13 asbestosclaims.law/library/18585/1

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Basic product information and performance data comparing RG-244 and other thixotropes is shown in bulletins F-70-090 and F-70-086. Additional literature about the use of RG-244 in other applications is also available. This report contains special considerations about RG-244:

MIXING
FILTRATION
SETTLING
GEL TIME STABILITY
VISCOSITY STABILITY
USE IN GEL COATS
DRAINOUT TIMES

MIXING

RG-244 can be dispersed into polyester resins with standard equipment such as the Homo-Mixer, Cowles Dissolver, and Ultrasonic Dispersers. Both large and small users have reported that it "wets-out" and disperses much more easily than pyrogenic silica.

Due to the range of resin types and viscosity and the variability of mixing equipment it is difficult to define mixing requirements exactly. Typical conditions for the Cowles Dissolver and Econosonic Disperser are shown in the literature. Commercial experience has been that one pass through an Ultrasonic Disperser gives an excellent, stable dispersion.

It is common industrial practice to "master-batch" pyrogenic silica at about the 5% addition level. The resulting very thick mixture is "worked" in a Cowles until some real heat is generated and is then diluted back to the desired concentration with monomer and/or additional resin.

Since RG-244 is designed for easy mixing, this type of intense shear is not necessary. In fact, over shearing for extended periods can cause some moderate loss in viscosity properties. This is illustrated in Table I, attached, where mixing in the Cowles at 3400 rpm for more than 20 minutes did reduce viscosity. Master batching may be useful with Calidria RG-244 where large resin batches are to be compounded with relatively poor mixing equipment. In this case, however, mixing conditions should be selected to allow for RG-244's relative ease of incorporation.

A07585

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ACL Doc 18585 · Page 2 of 13 asbestosclaims.law/library/18585/2

TABLE I

EFFECT OF SHEAR FORCES ON THE RHEOLOGICAL PROPERTIES OF RG-244 ASBESTOS IN POLYESTER RESIN*

RG-244 (phr)	Mixing Time (Min.)	Brookfield Viscosity (cps) at 25°C and 6 rpm Cowles 2000 rpm	Cowles 3400 rpm	Homo-Mixer ~5000 rpm
0.5	3	-	-	850
0.5	5	675	725	-
0.5	20	775	725	-
0.5	40	850	700	-
1.0	5	-	5000	-
1.0	20	-	4600	-
1.0	40	-	4400	-
2.0	3	-	-	19,500
2.0	5	25,500	25,500	-
2.0	20	24,000	22,000	-
2.0	40	20,000	13,500	-

*Polyester Resin - Rohm & Haas Corp. Paraplex P-43 polyester (base viscosity adjusted to 100 cps with styrene)

Mixing Parameters:

Cowles Dissolver - 3" diameter impeller
Homo-Mixer - 4 blades 2" diameter

FILTRATION

Calidria RG-244 is a fibrous material with a nominal diameter of about 0.025μ and a length of about 5μ. In spite of this small size, experience has shown that it will almost without exception plug a 100-mesh (150 micron) screen very rapidly. On the other hand, screens of about 60-mesh have been used with no problems reported. Recently, a successful test was made with a standard Cuno cartridge filter with a nominal average opening of 350μ. This falls about midway between 40 and 50 mesh.

Filter performance will depend on the amount of RG-244 present, the viscosity of the thickened system, and the flow rate of the resin through the openings in the filter. High local flow velocities will tend to align the fibers in the direction of flow and reduce viscosity. Both of these effects will contribute to making filtration easier.

As an added point of information, we have been told by the spray gun manufacturers that the 100-mesh filter frequently used in polyester spray-up

A07568

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ACL Doc 18585 · Page 3 of 13 asbestosclaims.law/library/18585/3

equipment is a holdover from the times when this type of gun was used to spray aqueous systems. Due to the tendency of such systems to flocculate, a "rule-of-thumb" of a factor of at least three between the filter and the hole in the gun came into use. Polyesters are basically non-flocculating systems and a 20-30 mesh screen is adequate to protect most guns.

SETTLING

It has generally been observed that Calidria RG-244, when properly dispersed, has very low settling rates. This is illustrated by the data in Table II below:

TABLE II

SETTLING RATE TESTS
PROMOTED(1) POLYESTER "BOAT" RESINS WITH 0.75% RG-244

		Typical Resin	Amine-Modified Resin
Brookfield Viscosity	6	1500	850
	60	650	400
Settling			
After 60 days		0	0
After 75 days		1/8"	1/2"

(1) Promoted by 0.3% by weight of 6% cobalt naphthenate

A comparison with pyrogenic silica in Koplac polyester after twelve days standing is shown in Figure 1. The RG-244 has not settled while the silica has dropped about 3/4".

Also of interest is the clarity of the resin containing the RG-244 compared to that with the pyrogenic silica. This demonstrates the high purity of RG-244 and the obvious refractive index match between this thixotrope and the resin. This clarity is sometimes an advantage.

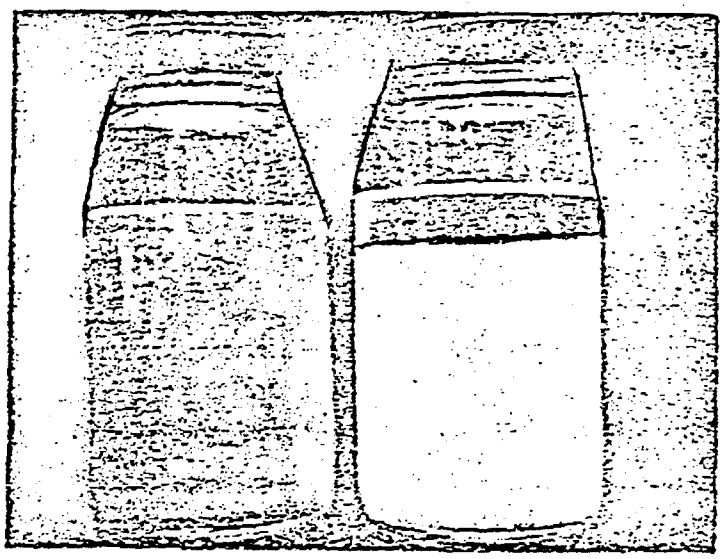
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ACL Doc 18585 · Page 4 of 13 asbestosclaims.law/library/18585/4

FIGURE I

KOPLAC Polyester & 30% Styrene
After Standing 12 Days



With R-G 244	With Colloidal Silica
0.7 phr added	1.0 phr added
η @ 2 rpm 1920 cps	η @ 2 rpm 1680 cps
η @ 20 rpm 440 cps	η @ 20 rpm 400 cps
Thix Index 4.4	Thix Index 4.2

GEL TIME STABILITY

The change in gel time as a function of the age of the resin was measured for a typical promoted polyester "boat" resin and for an amine-modified boat resin. Both resins were initially diluted to 60% solids by the addition of styrene. 0.3% by weight of 6% cobalt naphthenate was then added, followed by the thixotrope and each complete mix was blended for about 15 minutes with a Cowles dissolver. Finally each mix was portioned into small sample jars and stored in a constant temperature room at 70 $\pm$ 5°F.

Gel time was determined at periodic intervals with a Randolph gel timer. Lupersol DDM was used as the catalyst. An initial dosage of catalyst was selected for each system to give a gel time of about twenty minutes and this dosage was then kept the same throughout the study.

The results of this study are shown in Figures 2 and 3. Although there is considerable "cobalt drift" there does not appear to be any significant difference between either of the thixotropes and the base resin.

A07588

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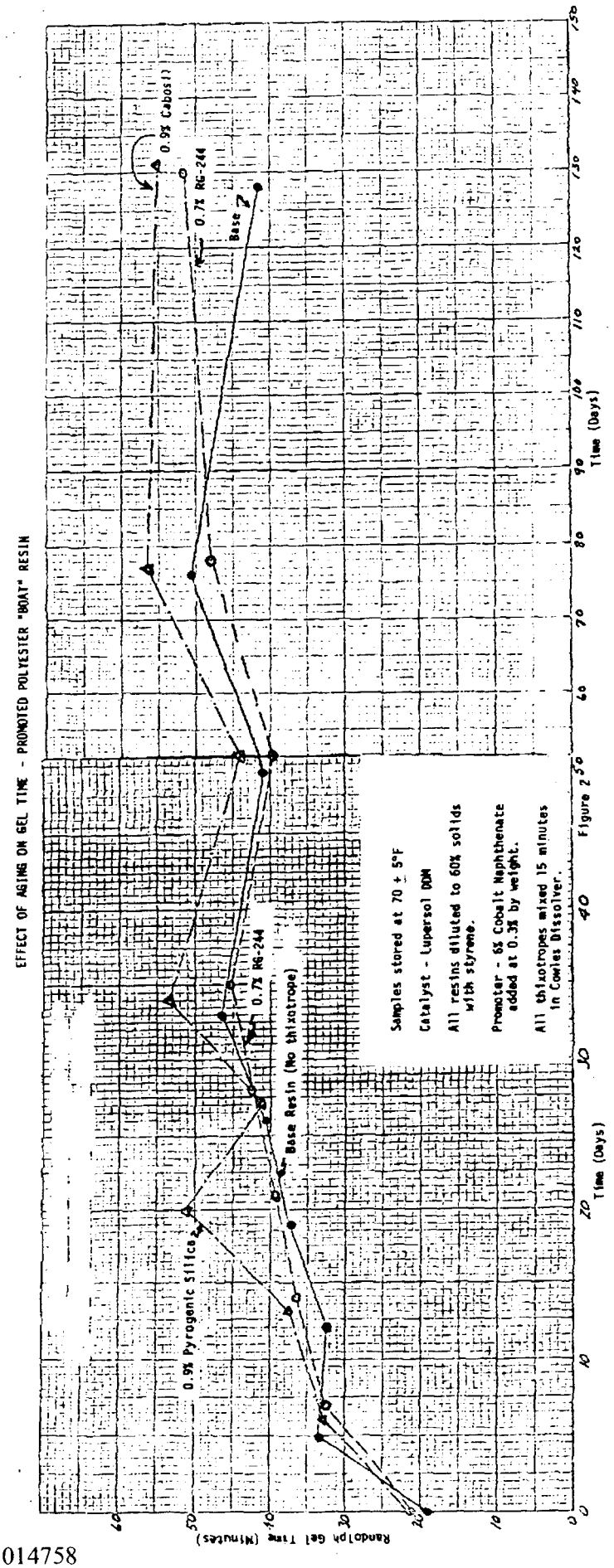


Figure 2

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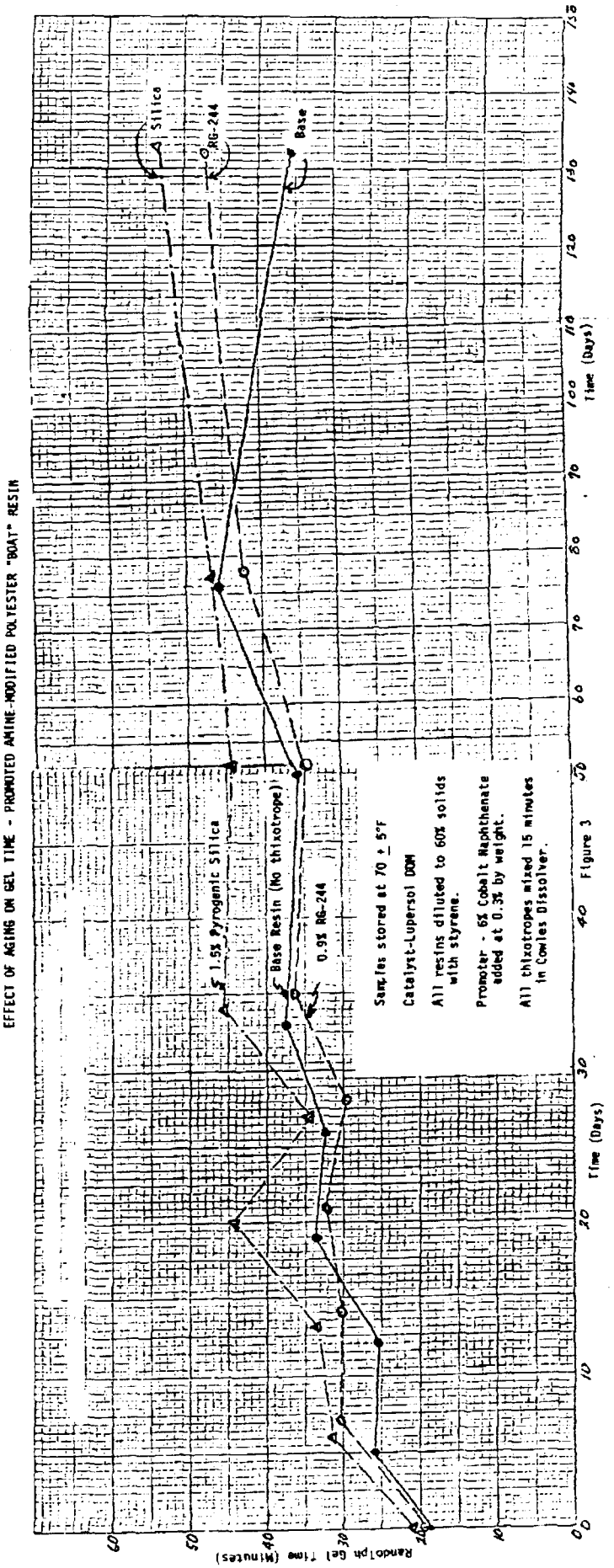


Figure 3

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VISCOSITY STABILITY

The change in Brookfield viscosity during ambient temperature storage for three RG-244 thickened resin systems is shown in Figures 4, 5, and 6. A typical polyester "boat" resin, an amine-modified boat resin, and a general purpose unsaturated laminating resin are illustrated. It appears from these results that RG-244 gives excellent viscosity stability and does not present any unusual viscosity stability problems.

A07591

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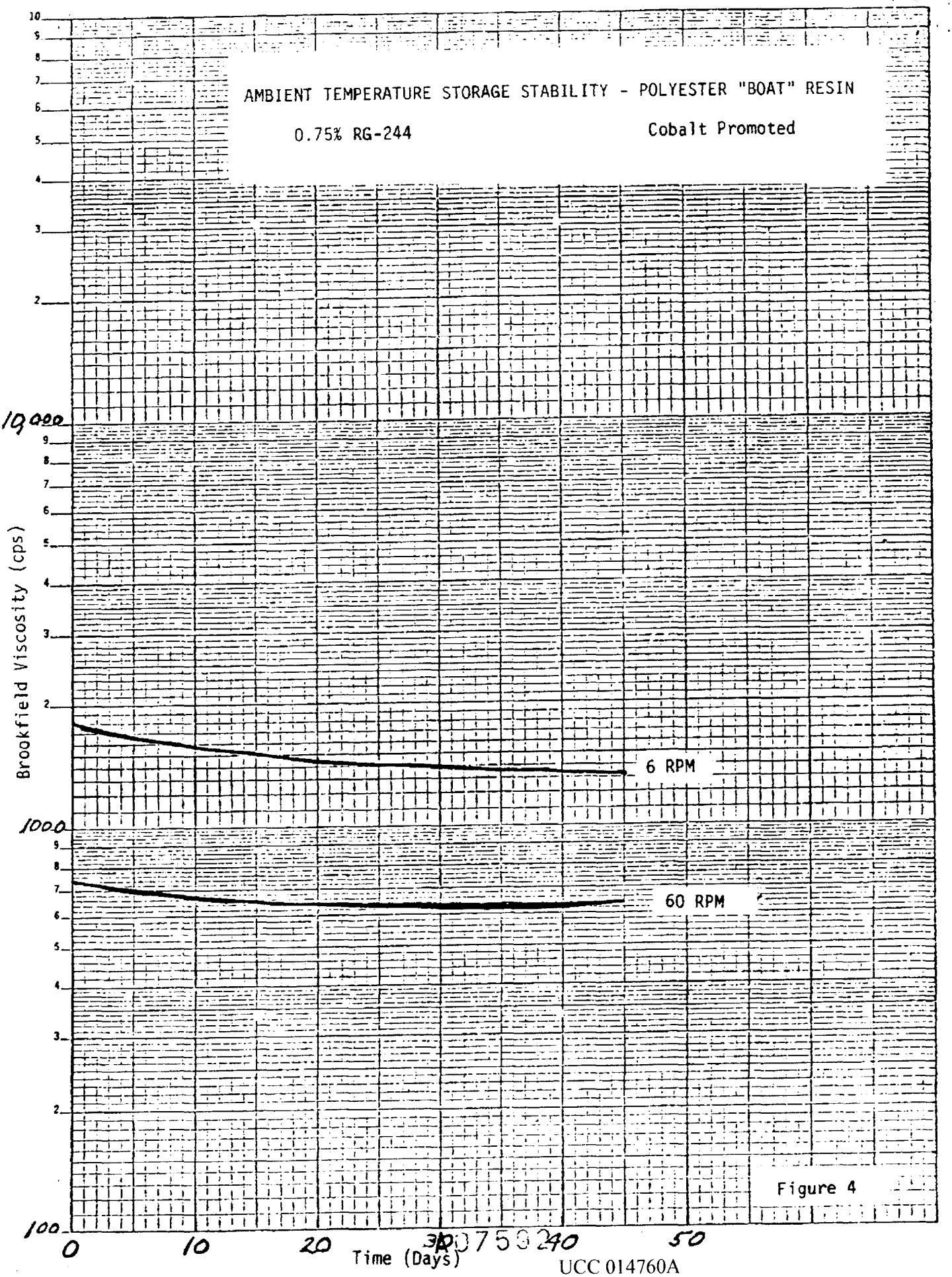

AMBIENT TEMPERATURE STORAGE STABILITY - POLYESTER "BOAT" RESIN
0.75% RG-244
Cobalt Promoted
Brookfield Viscosity (cps)
10,000
1000
100
6 RPM
60 RPM
0
10
20
30
40
50
Time (Days)
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Figure 4

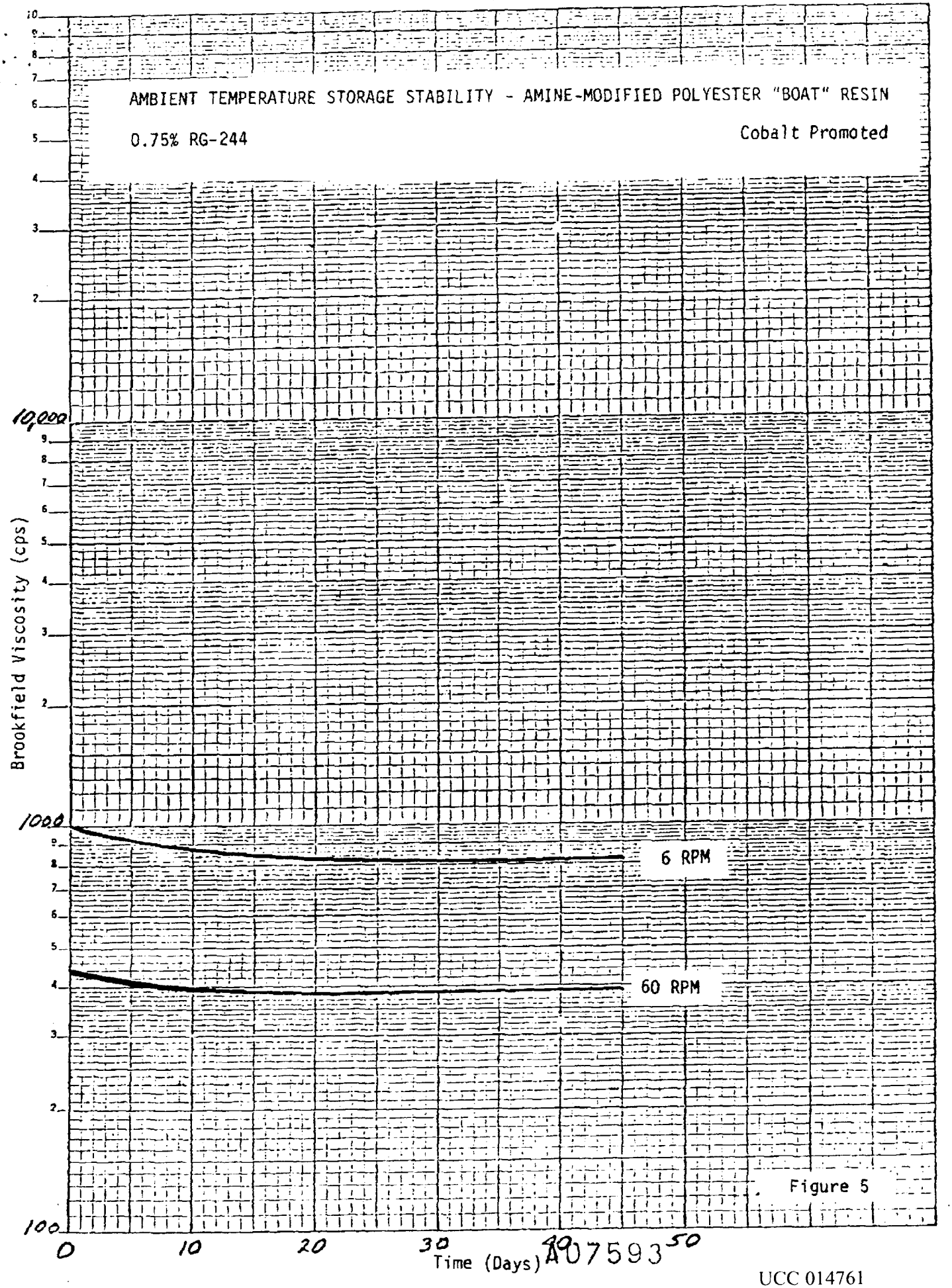


Figure 5

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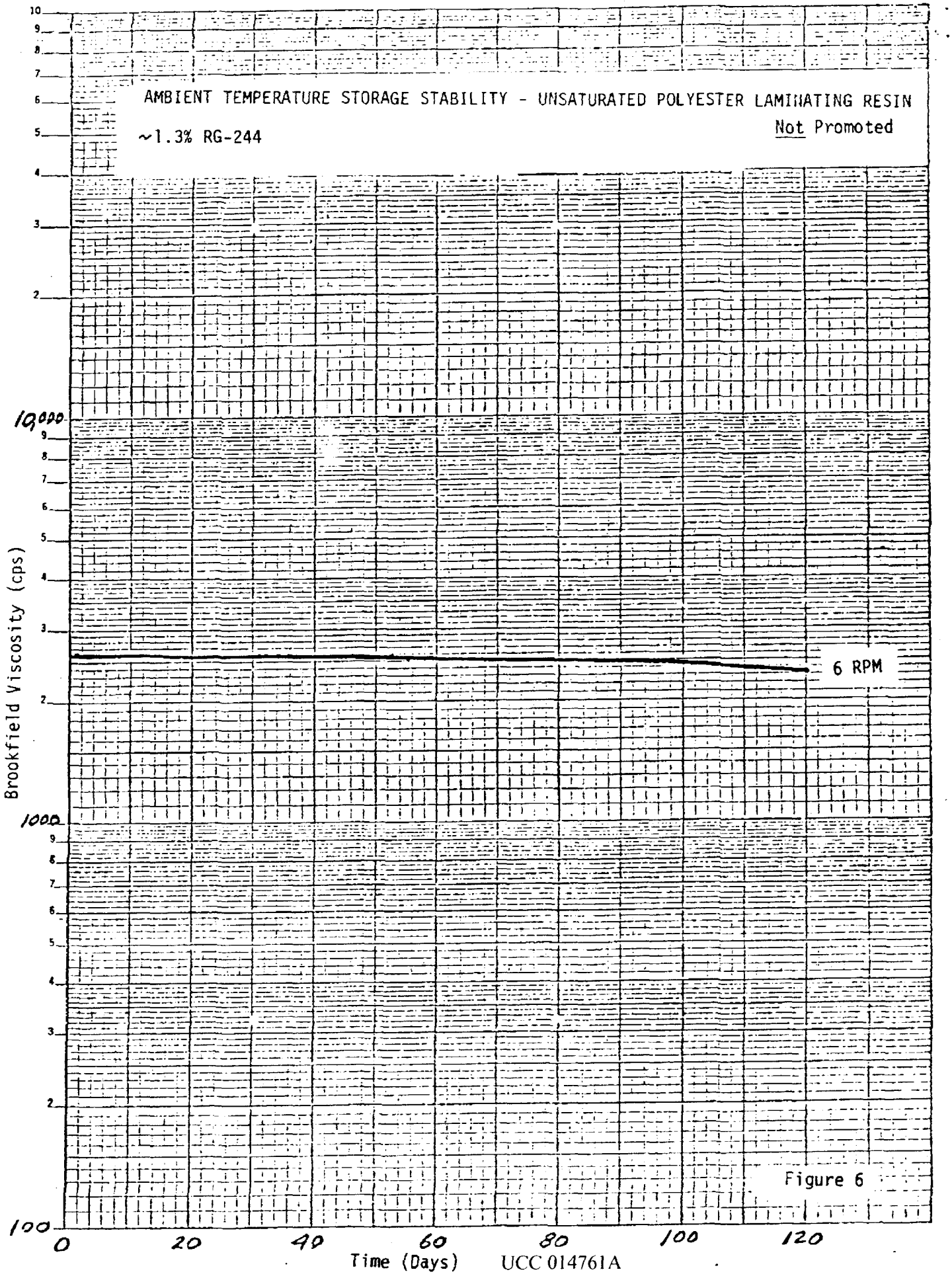


Figure 6

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USE IN GEL COATS

Polyester resins thickened with RG-244 will generally have a Hegman rating of 4-4.5. This reading is quite reasonable for a material having some particles in the 325 mesh size range. Contrary to what might be expected from such a low Hegman rating, RG-244 has been found to yield smooth gel coats with no protrusion of fiber ends. Sag resistance is excellent.

Also, as mentioned previously in the section on Settling, the refractive index of the RG-244 is close to that of polyester so an essentially clear gel coat results. This is in contrast to the "creamy" appearance typical of pyrogenic silica. The clarity is a significant advantage in applications where a pattern or decoration must show through the gel coat.

DRAINOUT TIMES

Drainout test procedures vary widely and are quite sensitive to technique and equipment used. It is thus difficult to provide any quantitative results with basic significance. Users of RG-244 generally have reported, however, that at comparable viscosities it cannot be distinguished from pyrogenic silica. This is illustrated by the test results listed in the table below.

These drainout tests were conducted utilizing 4" x 4" samples of 2-ounce glass mat. The resin was applied at the 75% resin-25% glass mat ratio and was hand brushed to leave about 1/4" of dry mat around the edges. After a five-minute soaking time, the sample was hung over the edge of a table on a cellophane backing and the time to drainout was recorded. Temperature was about 75°F.

DRAINOUT TESTS - KOPLAC 1030-5 RESIN

Sample	Brookfield Viscosity (Poises) 2 rpm	20 rpm	Drainout Time (Minutes)
Resin + 0.9 phr pyrogenic silica	14.0	4.3	50
Resin + 0.9 phr pyrogenic silica (duplicate)	14.0	4.3	80
Resin + 0.5 phr RG-244	12.0	3.8	49
Resin + 0.4 phr RG-244 + 0.3 phr ethylene glycol	12.0	4.0	50

A07595

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