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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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표지

United Nations Industrial Development Organization

PET.SYMP.

Interregional Petrochemical Symposium on the Development of the Petrochemical Industries in Developing Countries

Baku, USSR, 20 - 31 October 1969

SUMMARY

NEW POLYVINYLCHLORIDE FIBRES 1/

by

P. Mazzolini

Chatillon S.p.A.
Milan, Italy

A new catalytic system for the polymerization of vinyl chloride at very low temperatures, down to -60 C, has rendered easily and economically feasible the industrial production of polyvinylchloride with a high degree of stereoregularity, i.e. more crystalline, resistant to solvents, and with improved mechanical properties at higher temperatures.

New techniques were developed to transform this polymer into fibres ranking by far above the traditional PVC fibres in their overall properties.

The initial shrinking temperature reaches 130°C, as compared to 65°C for traditional PVC fibres. The new fibre can be easily dyed at

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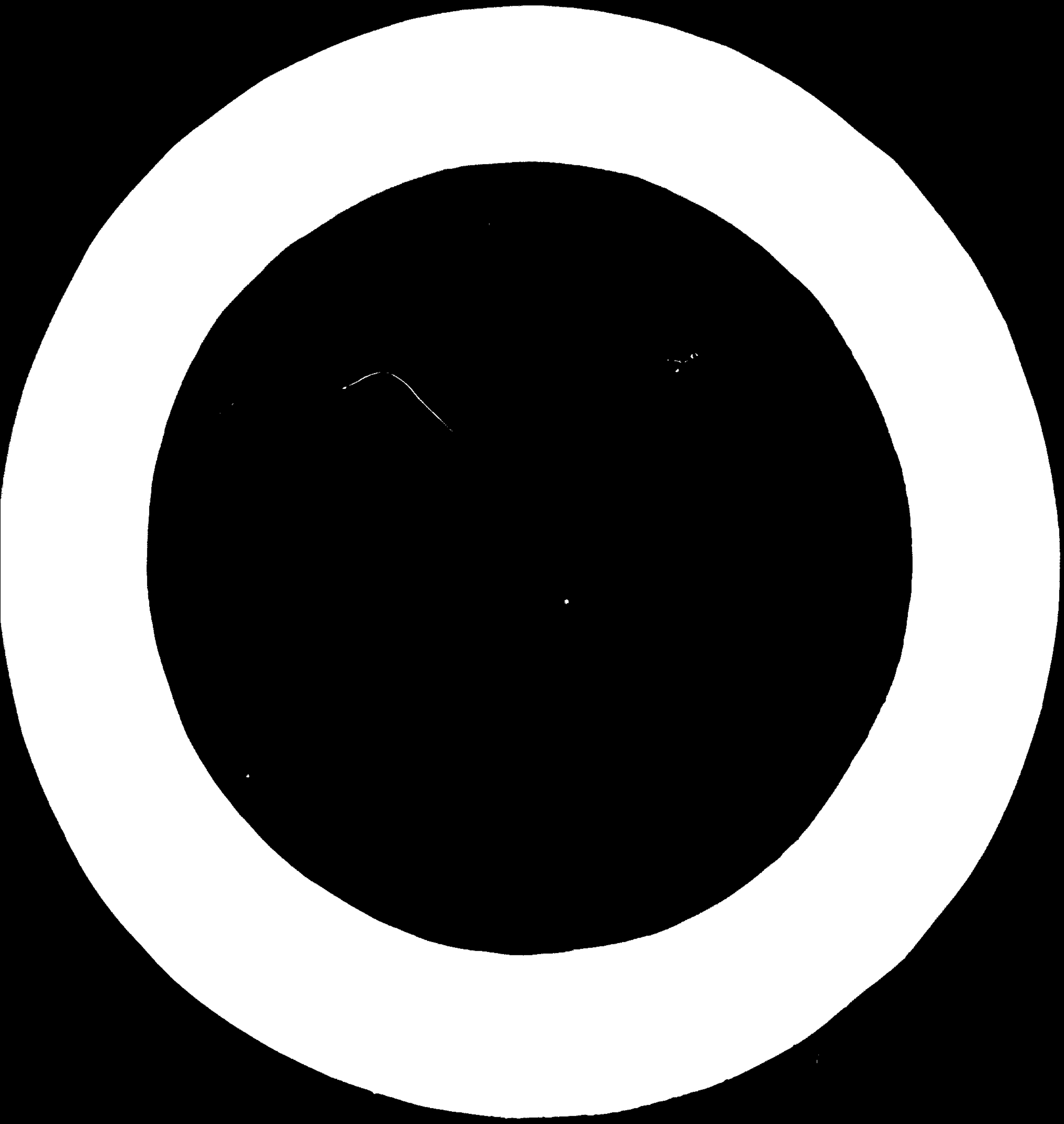
id.69-3846

high temperature and is resistant to dry-cleaning solvents. Due to its inherent property of non-flammability, joined with good processability and a pleasant wool-like hand, the new fibre is highly attractive for a wide range of textile applications.



[illegible] would [illegible]

[illegible]

[illegible]

[illegible]

[illegible] established [illegible]

[illegible] and tetrachloro- [illegible] immediate shrinkage, [illegible]

[illegible] fibres [illegible] industry, is sur- [illegible]

[illegible] chloride is, [illegible] consumption [illegible]

I can, [illegible]

[illegible]

[illegible] chemical [illegible]

[illegible] article [illegible]

[illegible]

[illegible] industrial [illegible] The tensil [illegible] of the fibers [illegible]

[illegible] ideas [illegible] in more [illegible] elastic modulus [illegible] fiber [illegible] than 10%.

The elastic modulus or Young modulus is the ratio, or more exactly the first derivative, of the [illegible] force in respect of the elongation, i.e. [illegible] of the [illegible] force-elongation curve. [illegible] will [illegible], [illegible] ar, [illegible] rigidity, in [illegible], which [illegible] in [illegible] of kg/mm².

[illegible] all [illegible] essential [illegible] rigidity, that characterizes textile fibres [illegible], like [illegible], or relative [illegible] for [illegible] with continuous [illegible].

[illegible] curve [illegible] fibres [illegible] remains almost constant up to [illegible], [illegible] fibres [illegible] gradually [illegible] increase of deformation.

[illegible] fibre, [illegible] its rigidity, [illegible], which is responsible for its [illegible].

[illegible] initial rigidity [illegible] make [illegible] immediately [illegible] for [illegible] and [illegible].

[illegible] mechanical properties like those possessed by wool [illegible] desirable for [illegible] of a synthetic fibre, it is [illegible] in quality and price between cotton and wool. [illegible] for acrylic fibres, [illegible], in [illegible] with [illegible] of wool, is indeed [illegible] factor in the enormous commercial [illegible] fibres.

It is [illegible] behaviour characterizes the fibres that, [illegible], all [illegible] to increase their dimensional stability [illegible] losses in mechanical properties.

A first [illegible] stabilizer forces, i.e. [illegible] which, [illegible] in boiling [illegible], do [illegible] chains [illegible], [illegible] gradual [illegible] chlorine [illegible], and also [illegible] resist [illegible].

The following [illegible] shall [illegible] head-to-tail [illegible] figure [illegible] the falling-off [illegible] noted [illegible] with respect [illegible] loss, [illegible] -chlorine [illegible] in the [illegible] and [illegible] with [illegible] fractions [illegible] unfavourable [illegible], furthermore, [illegible] only [illegible] stability [illegible] boiling [illegible]. Additionally, [illegible] fi [illegible] solvent [illegible].

[illegible] mechanical properties [illegible], [illegible] temperature [illegible], [illegible] Research Laboratories [illegible] company, now incorporated into [illegible] G.m.b.H. [illegible], with [illegible] different [illegible].

A particular feature [illegible] has been known for several years, i.e. [illegible] polymerization temperature. Since [illegible] chain transfer [illegible] favourable to the formation of polymers [illegible] chain branching; furthermore, [illegible] the formation of [illegible] in the case of PVC, an enrichment of [illegible].

[illegible] ization temperature decreases. [illegible] trends, found by means of infrared [illegible], determine correspond- [illegible] of the polymers, according to the correl- [illegible] crystallinity discovered by the Italian [illegible]

[illegible] polymerization [illegible] returns [illegible] considerations in polymer- [illegible]

[illegible], [illegible] previously [illegible] improved [illegible] – in which [illegible] of [illegible] stereo- [illegible] more pro- [illegible], owing to the lack of economic [illegible] polymerization, and [illegible] conversion into finished [illegible] for such materials, went- [illegible].

[illegible] production [illegible] attention of the [illegible] all-Italian [illegible] of [illegible] million [illegible] tion

The polymerization [illegible] discovery of a new catalytic system [illegible], down to -60° [illegible] is composed of [illegible] hydrocarbon [illegible] an alkali or alkaline- [illegible] alcohol [illegible].

It is worth [illegible] oxides and hydroperoxides [illegible] polymerization [illegible]

[illegible]

[illegible] the polymerization of vinyl [illegible]

[illegible] ion polymerization [illegible] groups, [illegible]

[illegible] magnesium [illegible] pletely [illegible].

[illegible] merization of [illegible] oxide) in [illegible] of vinyl chloride [illegible] hydroperoxide, [illegible] under [illegible] conditions [illegible] 0.0125% [illegible] eated.

Anybody [illegible] industrial importance [illegible] inexpensive materials. [illegible]

[illegible] perfect [illegible] cleaning [illegible] in [illegible]

[illegible] properties, [illegible] difference [illegible]

[illegible] no [illegible] finishing [illegible] during use [illegible] light ironing [illegible]

[illegible] those [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] rubbed, [illegible] electricity [illegible] formation of [illegible] [illegible]

[illegible]

[illegible] ill- [illegible]

[illegible] intrinsic [illegible]

[illegible] [illegible] -ection.

[illegible] [illegible] [illegible] -cialwhite [illegible] having [illegible], [illegible] types, mass-[illegible]

Table 7 [illegible] fibre. [illegible] in [illegible] reference in [illegible] [illegible] natural fibres. [illegible] tensile strength. In fact, [illegible] tensile strength for the finest fibre in the table is 1.[illegible], [illegible] for the 25 den, [illegible] 18 [illegible].

The same table lists [illegible] determination indicates the [illegible] fibres. [illegible] values recorded for [illegible].

The [illegible] of the fibre in [illegible] conditions in service, [illegible] fibres.

[illegible] properties, that is [illegible] temperatures. [illegible] of its tenacity. The table illustrates [illegible] fibres in like conditions. [illegible] 90°C, and [illegible].

Not only does [illegible] relative to the conditions [illegible] it seems [illegible] washing, including [illegible] formation or folding.

[illegible] (Fig. [illegible]) [illegible] of Rhovyl in trichloro-ethylene, which is the [illegible] dry-cleaning solvent, is compared [illegible] normal dry-cleaning [illegible] stability.

[illegible], [illegible] Acetone, [illegible] temperature [illegible] without [illegible].

[illegible] Rhovyl, we [illegible] other [illegible] fibres), Rhovyl [illegible] such as [illegible] is thus [illegible] of dis-[illegible] orientation [illegible] are [illegible] both.

[illegible] fixed [illegible] structure in [illegible], that is [illegible] than the [illegible] "[illegible]-up" inter-molecular [illegible], or [illegible] molecular [illegible]. [illegible] limited the [illegible] only [illegible] measured at [illegible]

110°C in industrial processing, [illegible] different [illegible] which the fibre [illegible] in this manner [illegible] in [illegible], [illegible] without [illegible] (generally [illegible] [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible], [illegible] [illegible] [illegible]. [illegible] [illegible] [illegible] [illegible] [illegible]. [illegible] (Fig. 1[illegible]) [illegible].

The most important applications of Leavil have been [illegible] all [illegible] types of [illegible] knitting, [illegible] with 100% [illegible] fibre and in [illegible] with other natural, artificial or synthetic fibres such as wool, cotton, acrylic fibres, rayon, [illegible], etc.

[illegible] types of [illegible], [illegible] non-[illegible] [illegible], [illegible], [illegible] fabrics, [illegible] fabrics. [illegible] the processing [illegible] without any difficulties. [illegible] mechanical properties [illegible] formations ([illegible]) during [illegible], thus ensuring [illegible] "[illegible]" caused by residual stresses.

Leavil can also be used [illegible] for the production of bulked yarns for [illegible] knitwear [illegible] for the analogous version of acrylic fibre [illegible] of the fibre is given [illegible] stretching [illegible] stresses released in boiling water or steam, with [illegible] shrinkage of the portion of fibre [illegible]. The contraction of the shrinked fibre crimps and [illegible] the other fibres in the yarn, giving [illegible] swelling, soft appearance which is particularly [illegible] knitwear. Here, too, there is [illegible] with [illegible] ments on other [illegible] fibres: even after shrinkage, [illegible] fibres [illegible]

[illegible] properties of the starting fibre, whereas [illegible] fibres the [illegible] effects were obtained [illegible] rise [illegible] in the fibres.

[illegible] fabrics [illegible] plastic [illegible], [illegible] fibres [illegible] fabrics, [illegible] The fibres [illegible] in [illegible] fabric. [illegible].

[illegible] itself to [illegible].

[illegible] its specific [illegible].

[illegible] risks of [illegible], [illegible] installations [illegible], [illegible], vibration, transport, [illegible] low, [illegible], [illegible] fixed installations [illegible] for [illegible], [illegible], theatrical [illegible] the use of [illegible] persons. And [illegible], [illegible] locations, [illegible]. [illegible], [illegible] will surround us with safety, and Leavil will be well appreciated for those most exposed to fire dangers or illness [illegible] times, the aged and children. Leavil is in [illegible] its [illegible] fire-ness, its freedom from [illegible] resistance to chemical action or allergies make it [illegible] for pyjamas, underwear, bedding, etc., all of which [illegible]. [illegible], [illegible] especially indeed.

[illegible] is [illegible] Leavil. [illegible] of Leavil [illegible] Leavil [illegible], [illegible] than ever. In these applications the aesthetic [illegible] with the non-flammability – which is particularly important for bulky and open structures such as that of [illegible].

[illegible], [illegible], [illegible] and [illegible] for personal use, are equally [illegible] applications for Leavil.

Leavil's chemical resistance [illegible] protective clothing, [illegible], [illegible] personal [illegible] in the presence of corrosive substances, and for industrial applications, such as filters and felts, which can also be used in high temperature conditions.

We shall conclude this paper with the mention of two types of blends of Leavil with other fibres, which exemplify a most successful combination of the properties of the components.

The first of such blends are the Leavil/[illegible] blends, suitable for carpet yarns. The high quality of [illegible] in acrylic fibres is wellknown: they have incomparable fibre [illegible] maintains over time the rich, dense appearance of the carpet when new. If Leavil is introduced into the yarns to the extent of 20% - 30%, depending on the type of carpet, it not only maintains the already excellent wear characteristics, but also improves the aesthetic appearance; and of course it confers full security against possible flame-spreading dangers.

The use of blends made from [illegible] Leavil and traditional PVC fibres, such as Movil, are of particular interest because they show how the introduction of a new synthetic fibre does not, as a general rule, [illegible] those already existing and indeed, in certain cases, promotes the use of them. In the production of [illegible] fabrics with Movil/Leavil blends, pro- [illegible] the fibre-pile cut [illegible] treatment causes the shrinkage of the traditional PVC fibre; thus producing two levels of fur, one inner – short – and [illegible] – longer and outer – and thus perfectly imitating the fur of certain animals. If fibres of different [illegible] are blended, it becomes possible to [illegible] typical of [illegible] furs.

Leavil has been in production for over one year in an industrial plant [illegible] Company of Chatillon [illegible] provisions for [illegible] the capacity [illegible].

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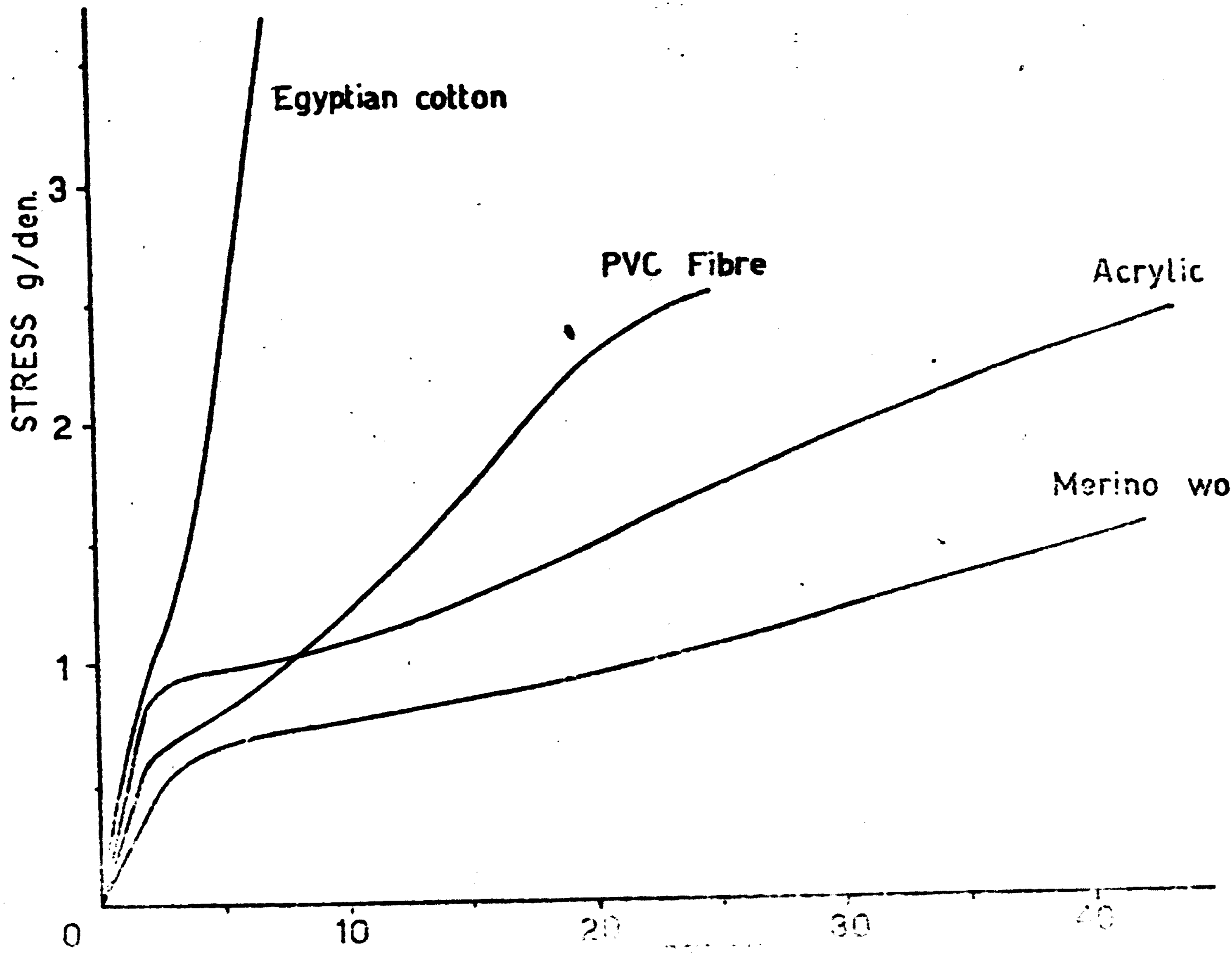
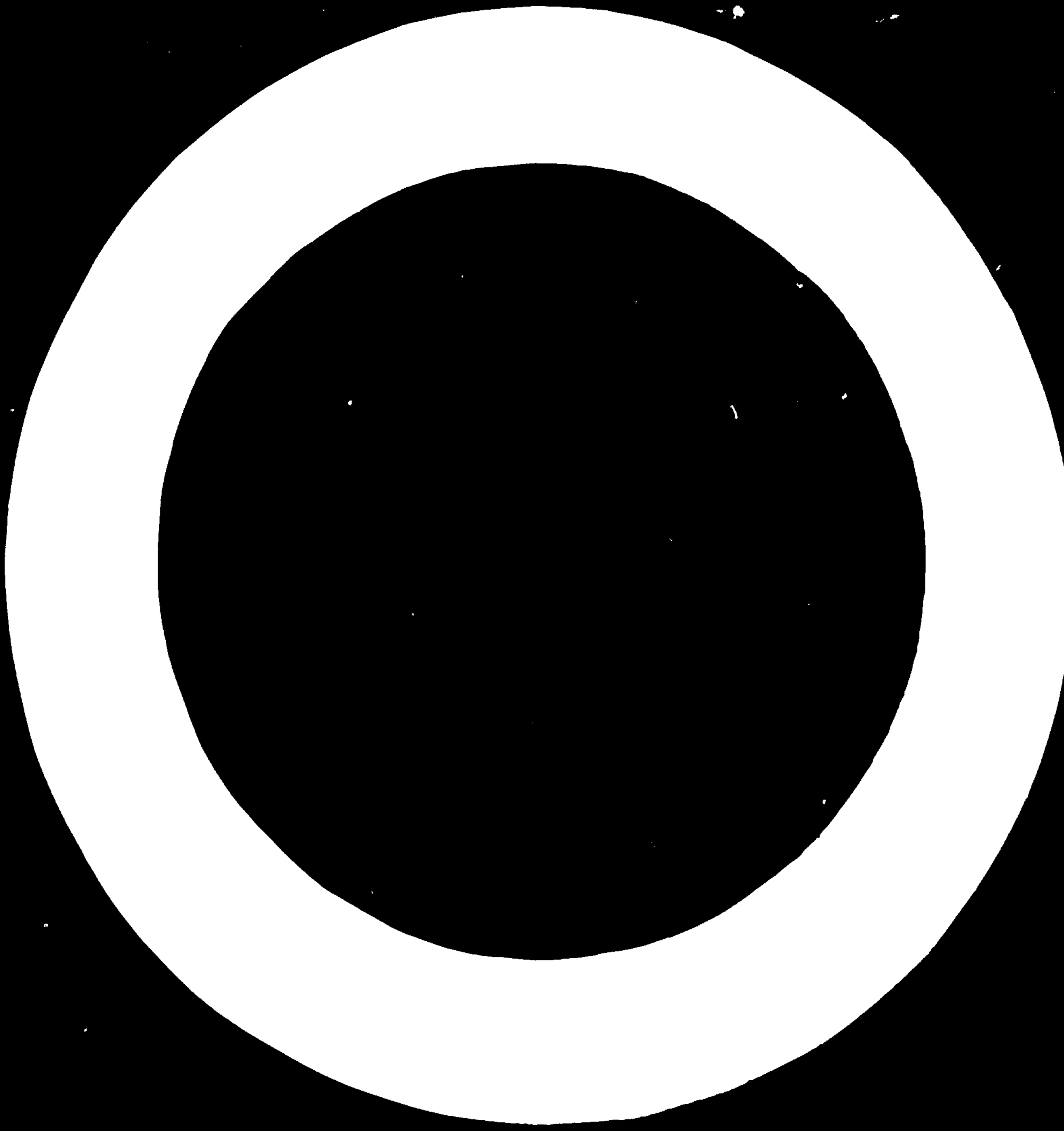
STRESS STRAIN CURVES AT 21°C AND 65% R.H. FIG.1





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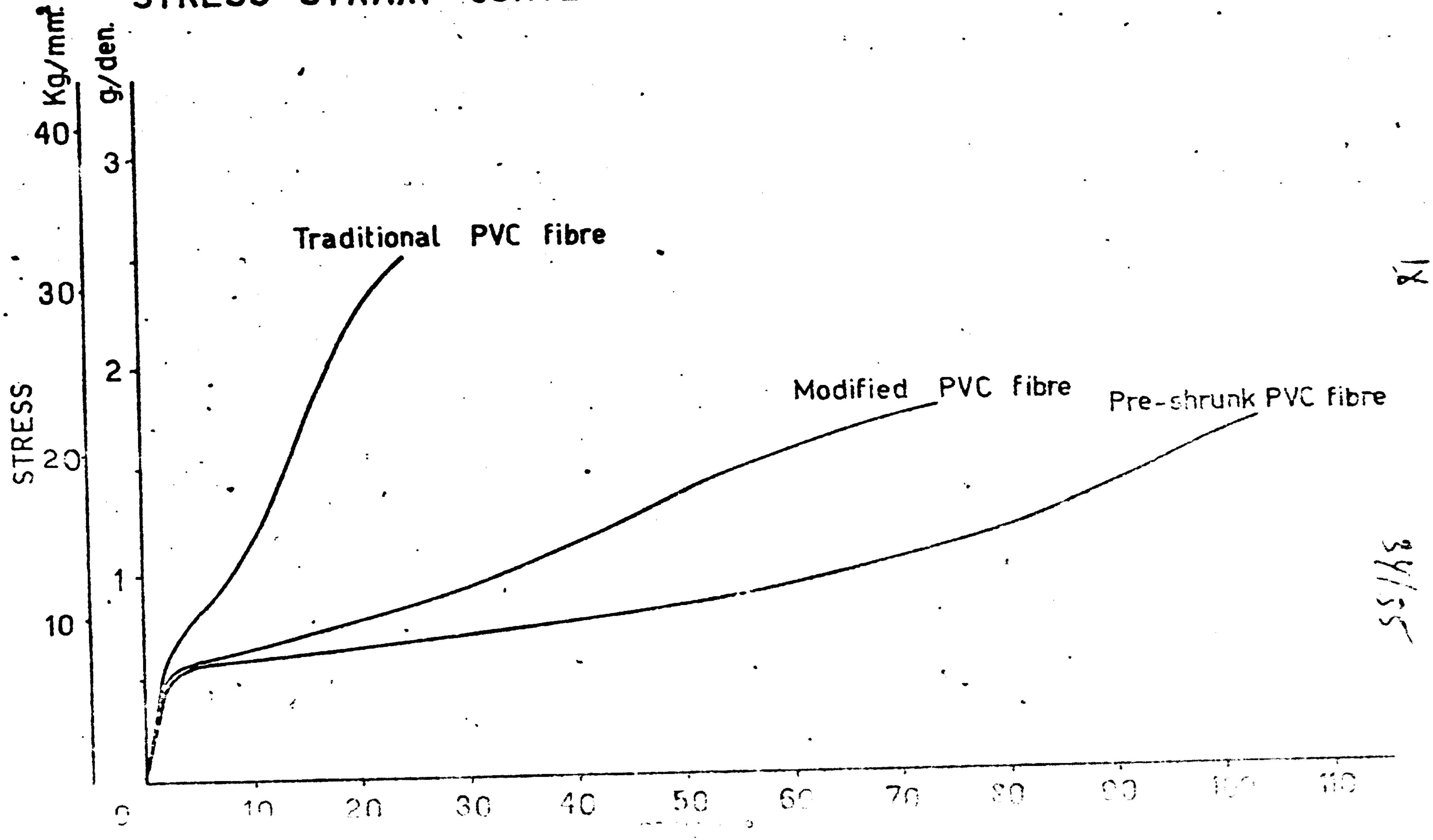
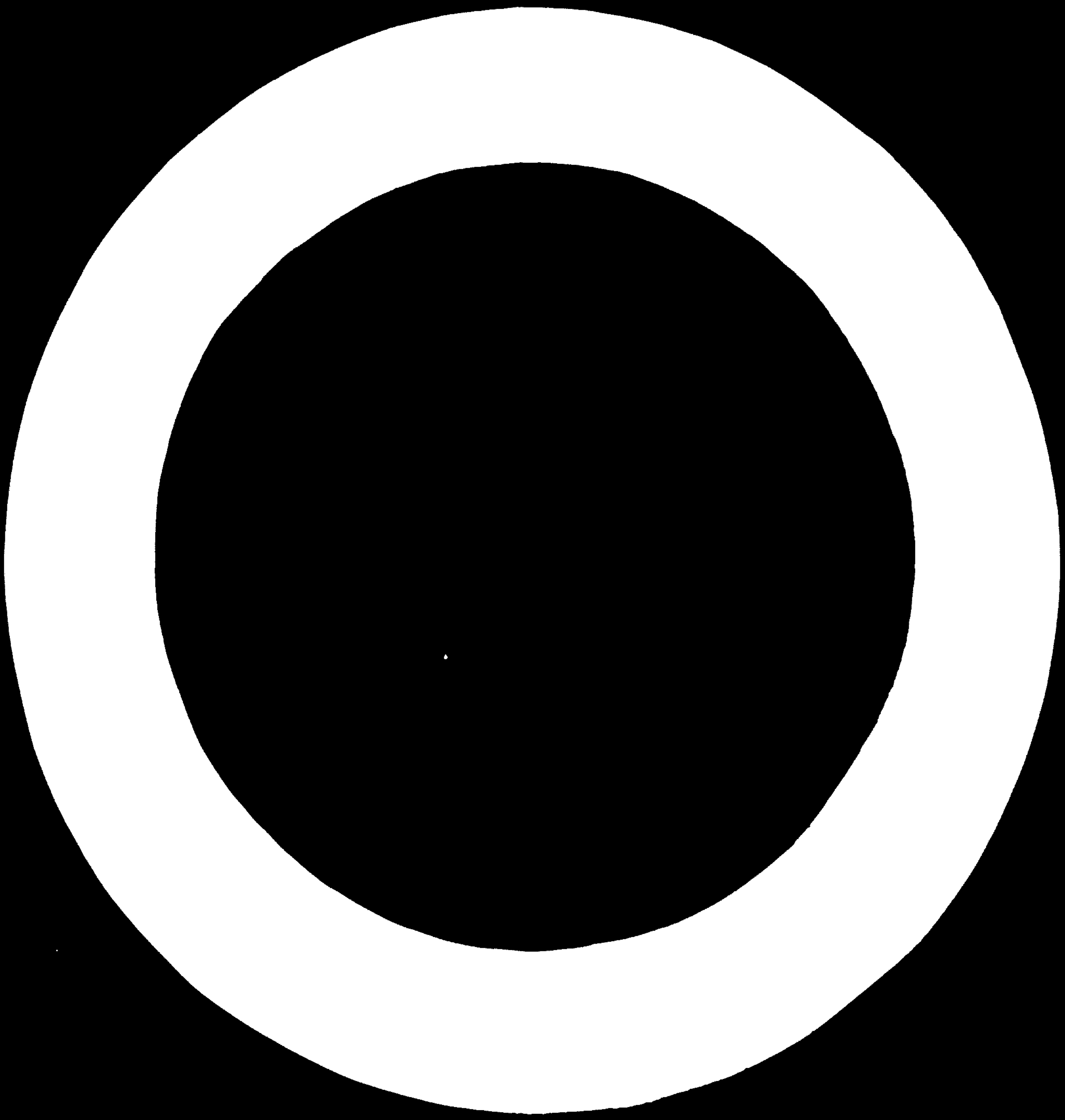
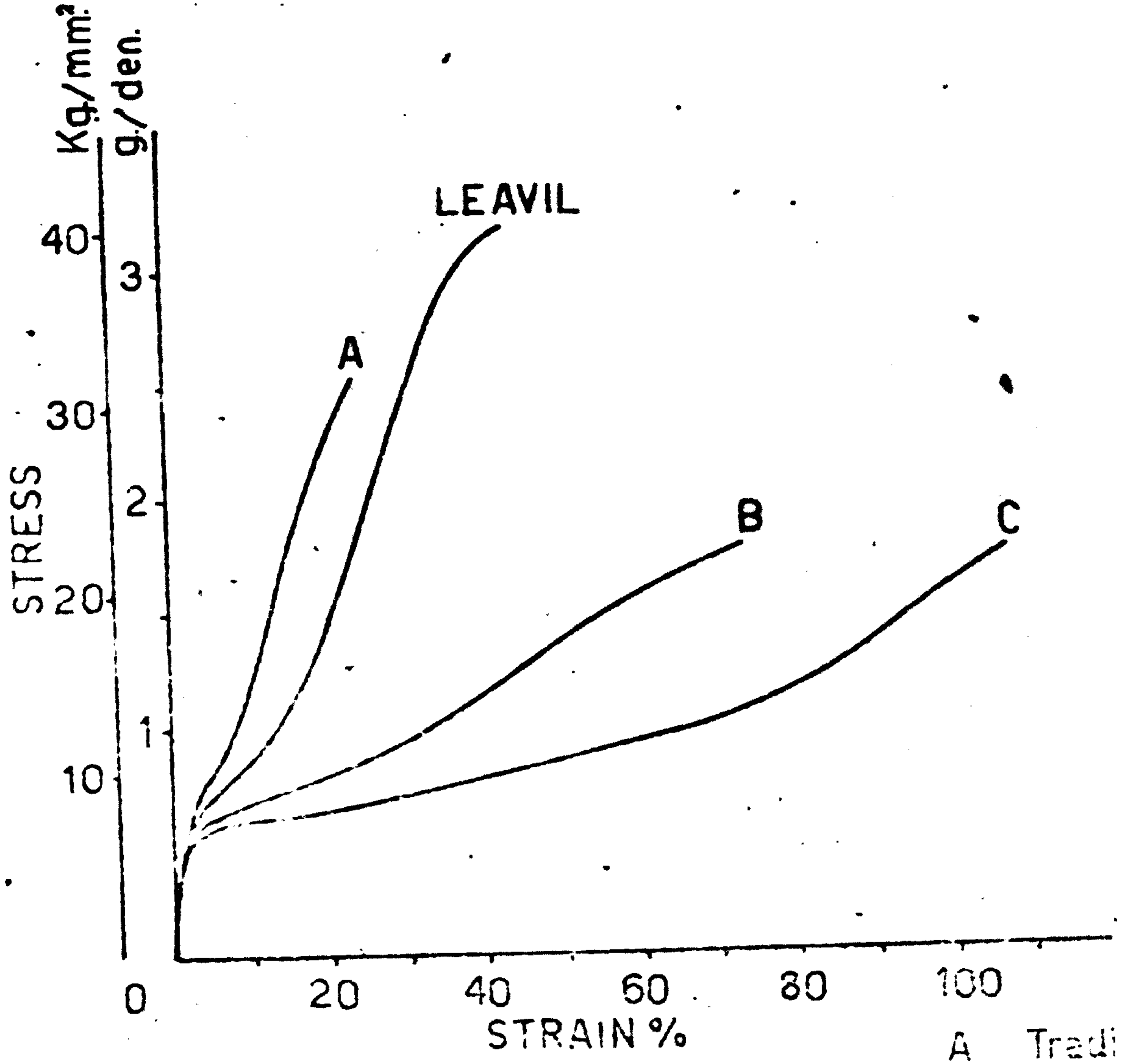
STRESS STRAIN CURVES AT 21 °C AND 65% R.H.

FIG.2

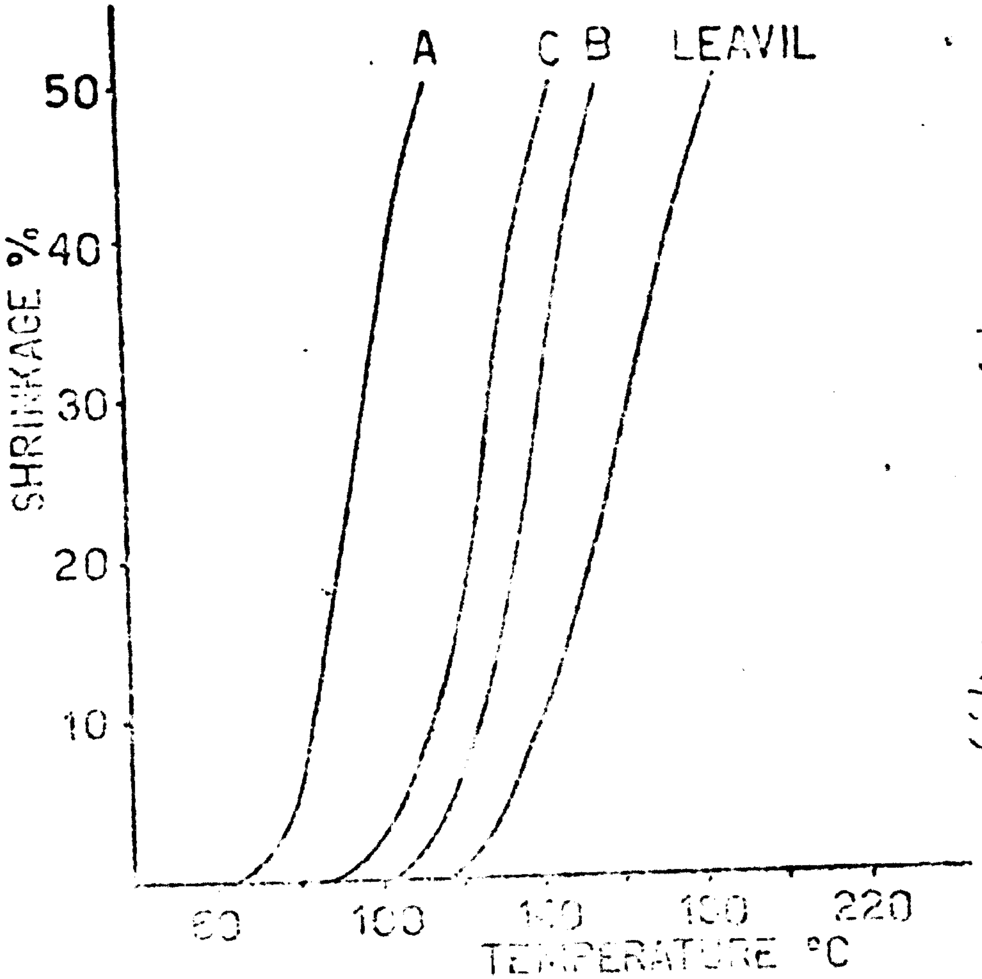




STRESS STRAIN CURVES
AT 21°C AND 65% R.H.



[illegible]
OF PVC FIBRES IN AN INERT
MEDIUM (SILICON OIL)



A Traditional PVC fibre
B Modified PVC fibre
C [illegible]

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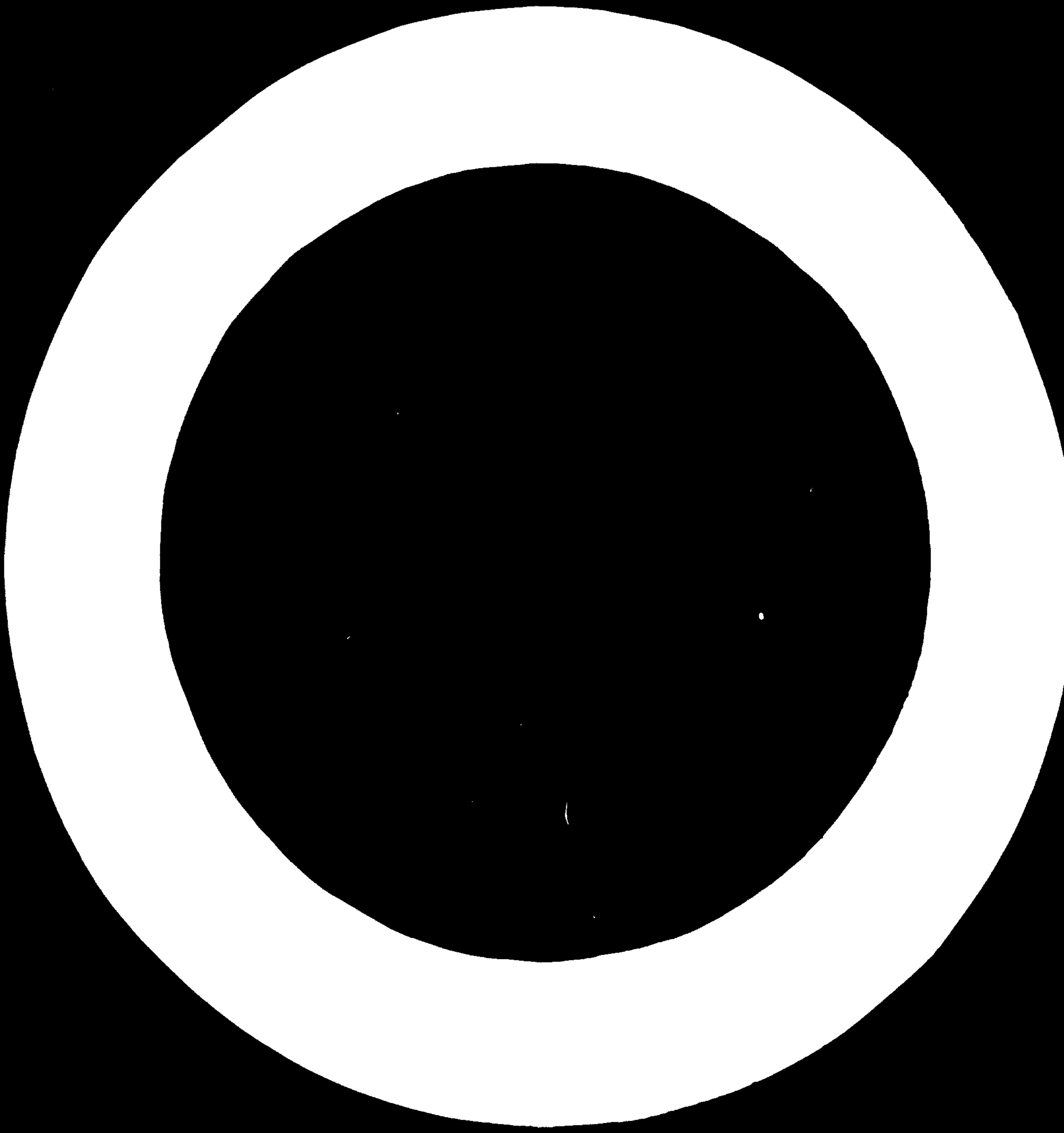
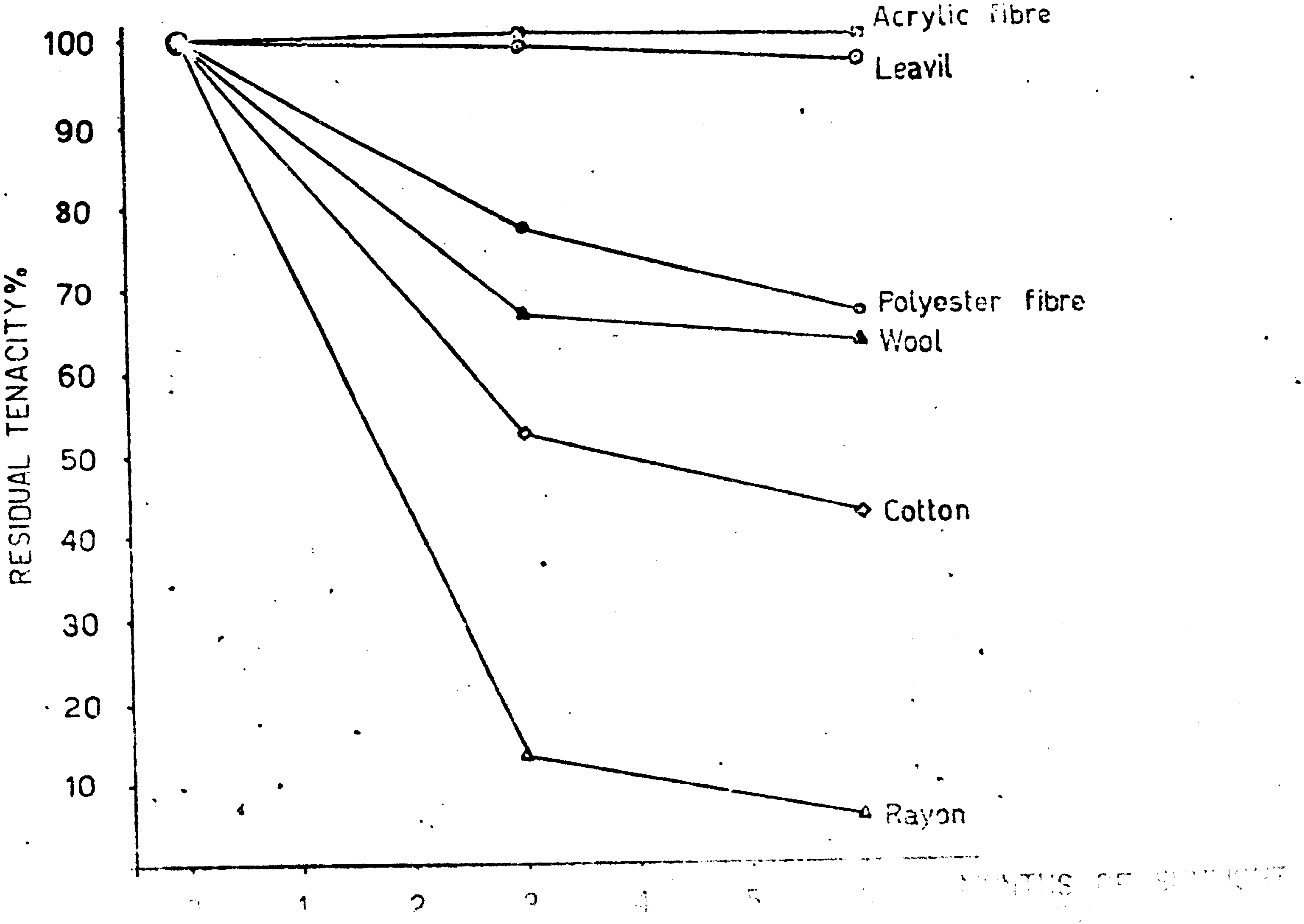


SUNLIGHT FASTNESS



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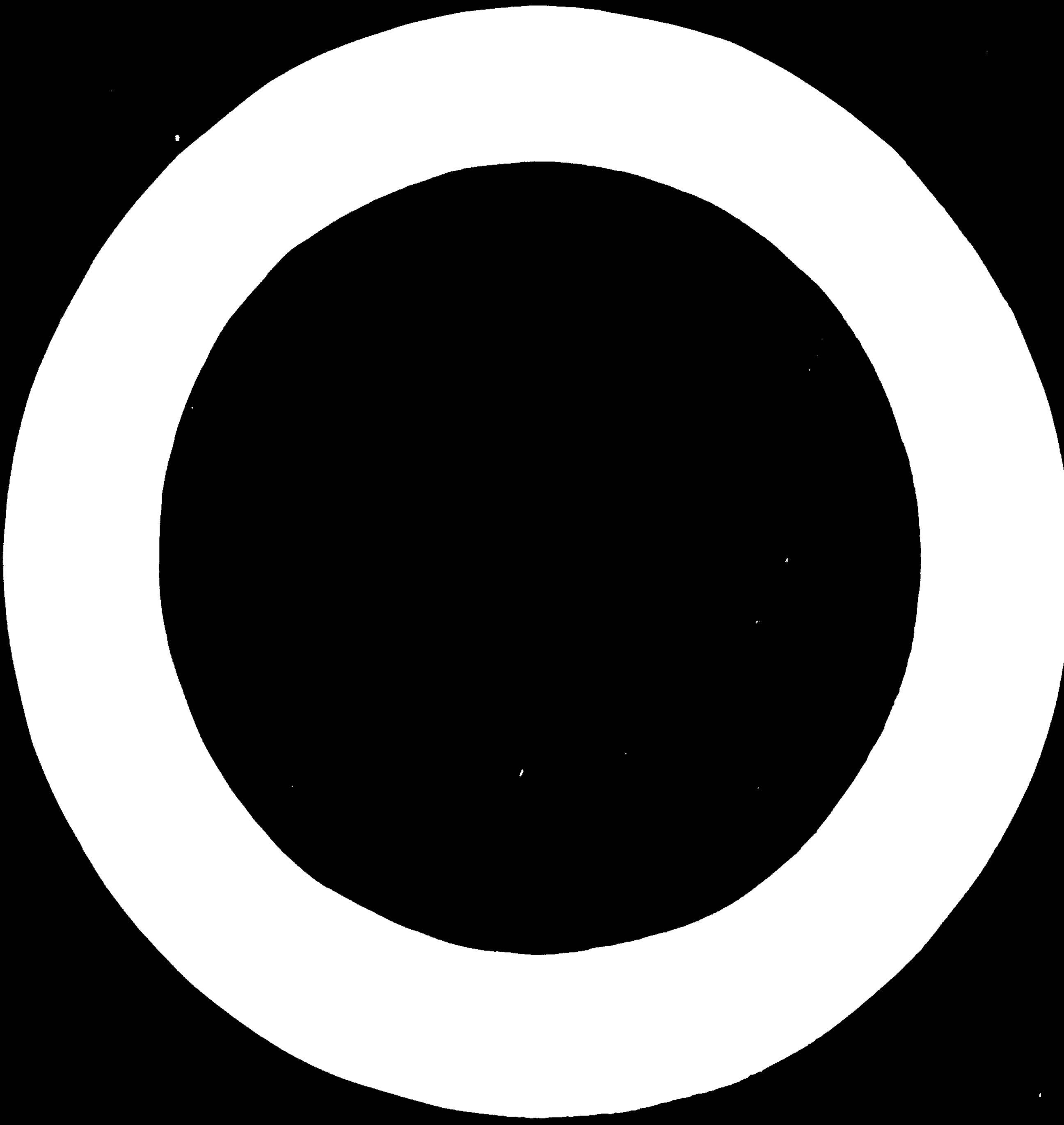
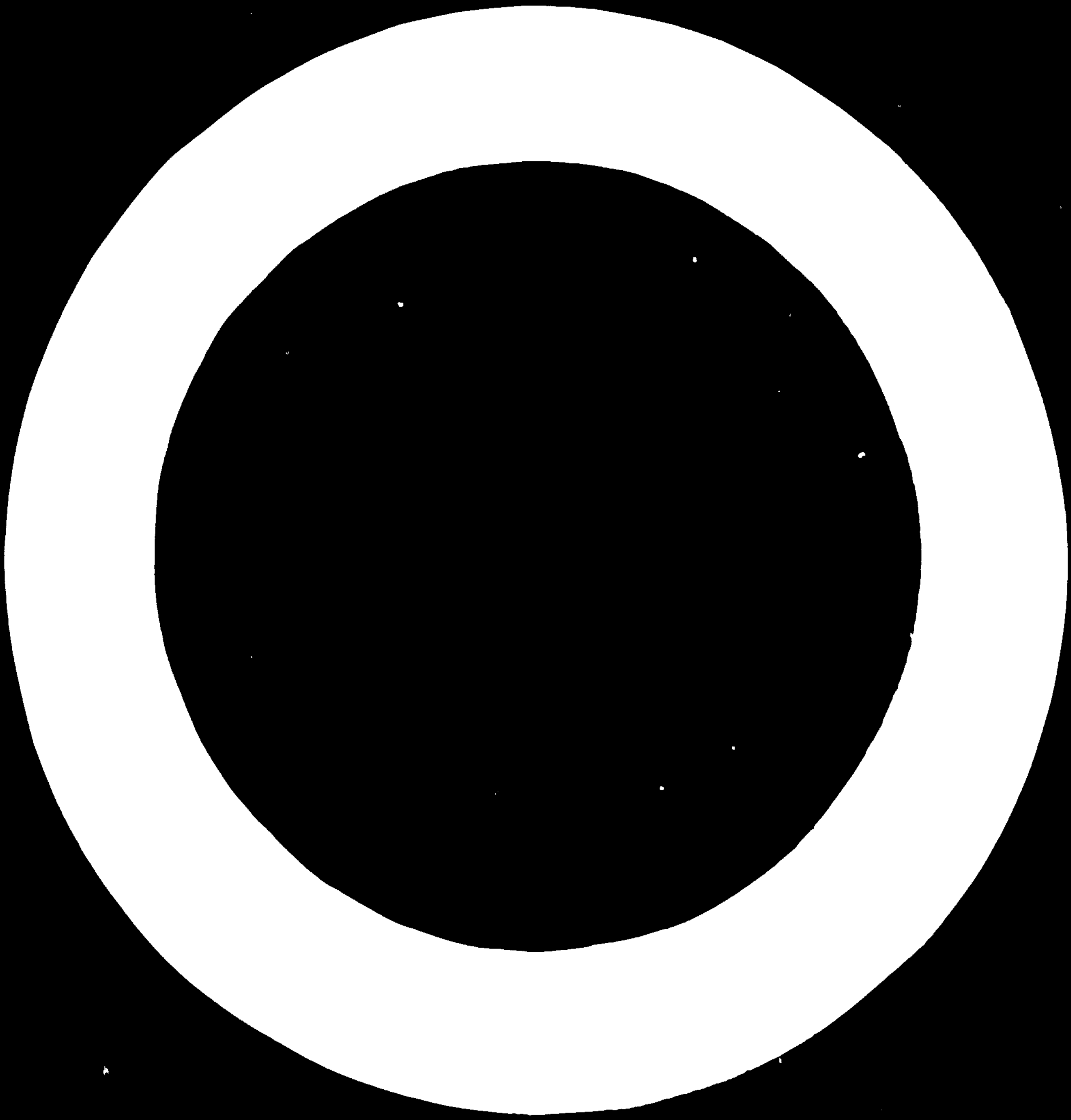


Fig. 5 - LEAVIL resistance to chemical agents

Solution	Test conditions	Weight loss %	Tenacity g/den	Elong. %	Elastic Modulus g/den	[illegible]
-	as such	-	3.3	50	30	-
2% HNO_3	168 hours at 20°C	0.45	2.25	50	30	-
2% H_2SO_4	168 " " 20°C	0.20	3.3	50	29	-
2% HCl	168 " " 20°C	0.60	3.3	47	30	-
2% NaOH	168 " " 20°C	0.20	3.2	49	27	-
2% H_2SO_4	1 hour to boil	1.5	3.3	49.5	28	
30% H_2SO_4	1 " "	1.5	3.25	50	30	-
2% NaOH	1 " "	0.8	3.2	50	27	Yellows
30% NaOH	1 " "	0.8	2.8	50	30	Yellows



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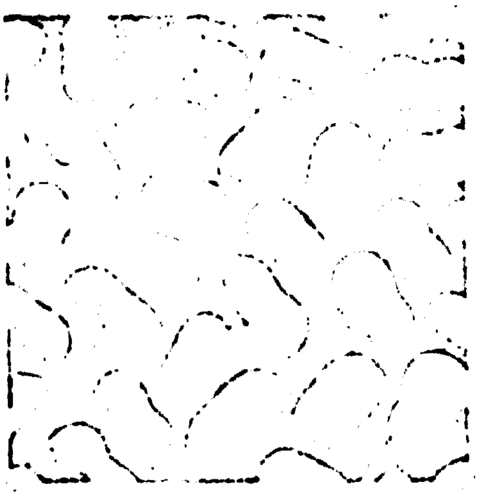
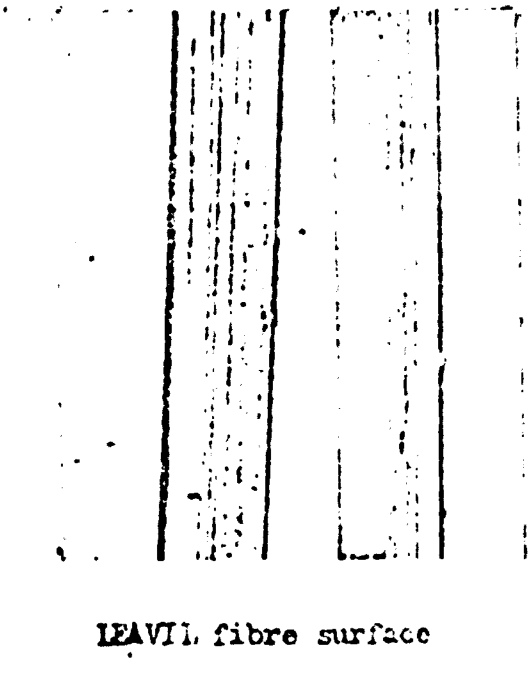


LEAVIL fibre cross-section



LEAVIL fibre surface

500 X

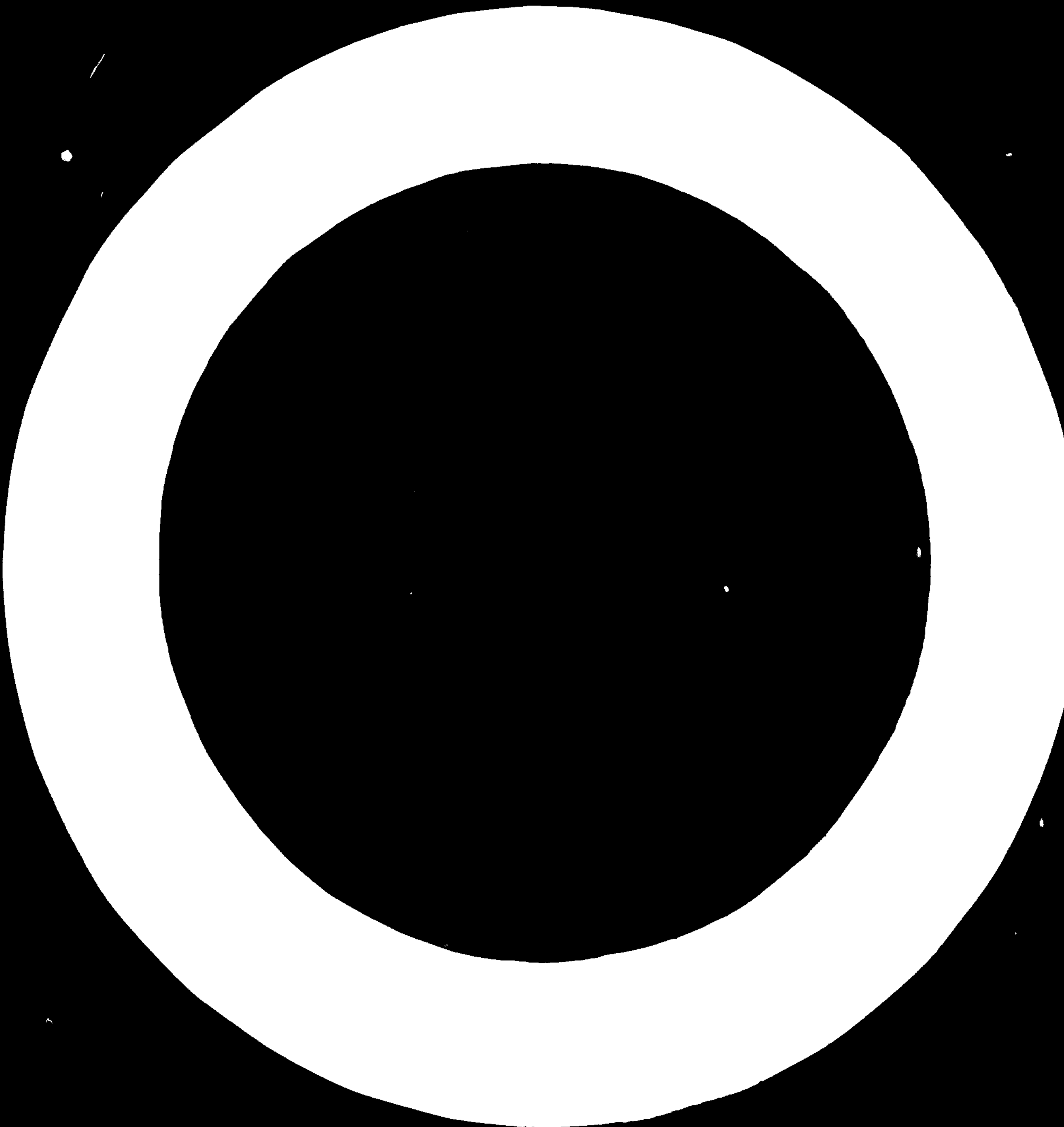


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Fig. 7 - [illegible] fibre properties (commercial deniers)

Denier	Tenacity g/den	Elongation %	Elastic Modulus g/den	Yield Point g/den	Wet Tenacity g/den	[illegible]
1.5	3.30	36	30	0.60	2.8	[illegible]
2.0	3.20	38	29	0.55	2.7	[illegible]
3.0	3.10	40	28	0.55	2.5	[illegible]
5.0	2.9	46	27	0.50	2.1	[illegible]
8.0	2.8	50	27	0.50	1.9	70
15.0	2.6	60	27	0.50	1.7	[illegible]
25.0	2.3	70	24	0.50	1.4	[illegible]

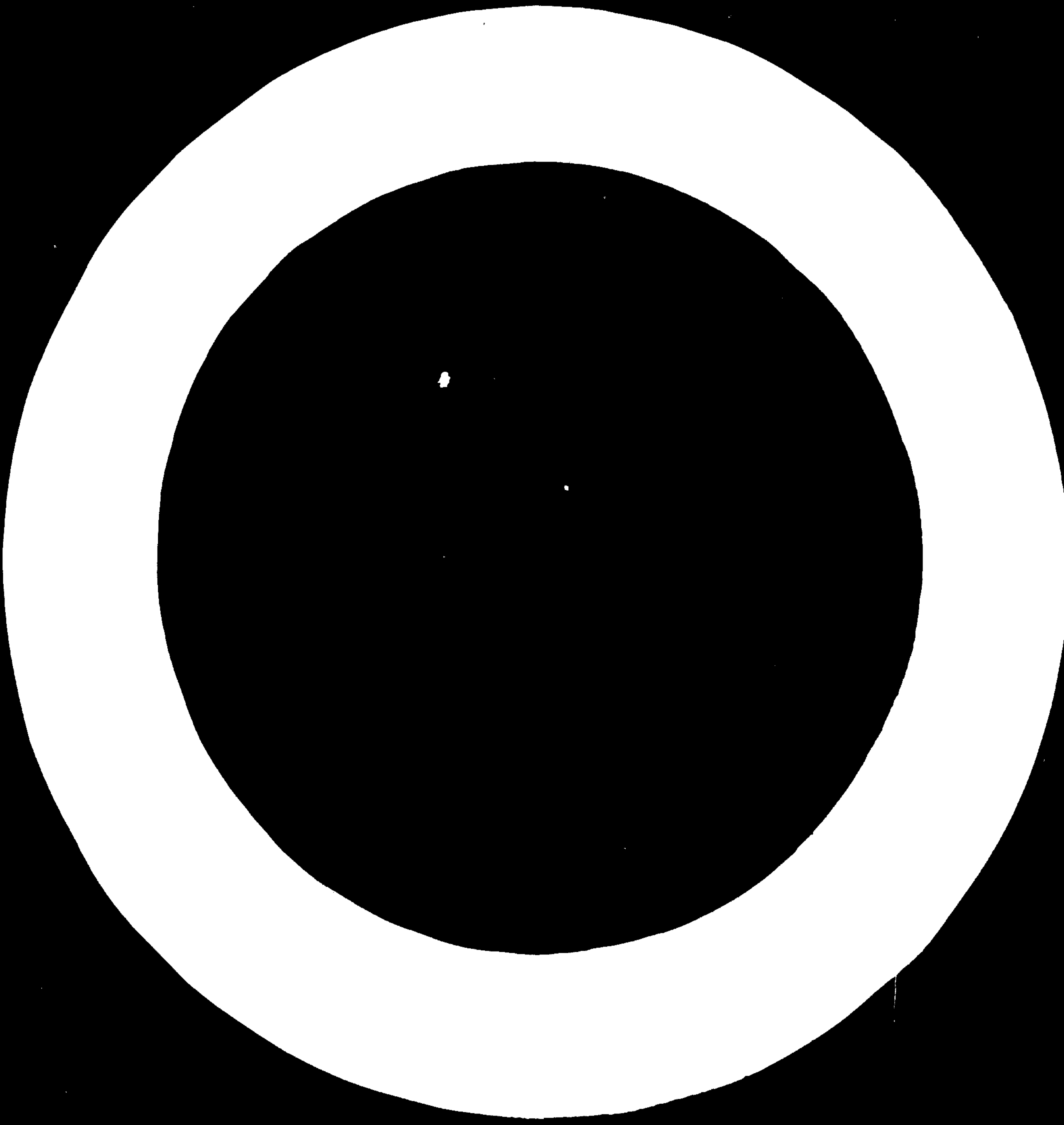

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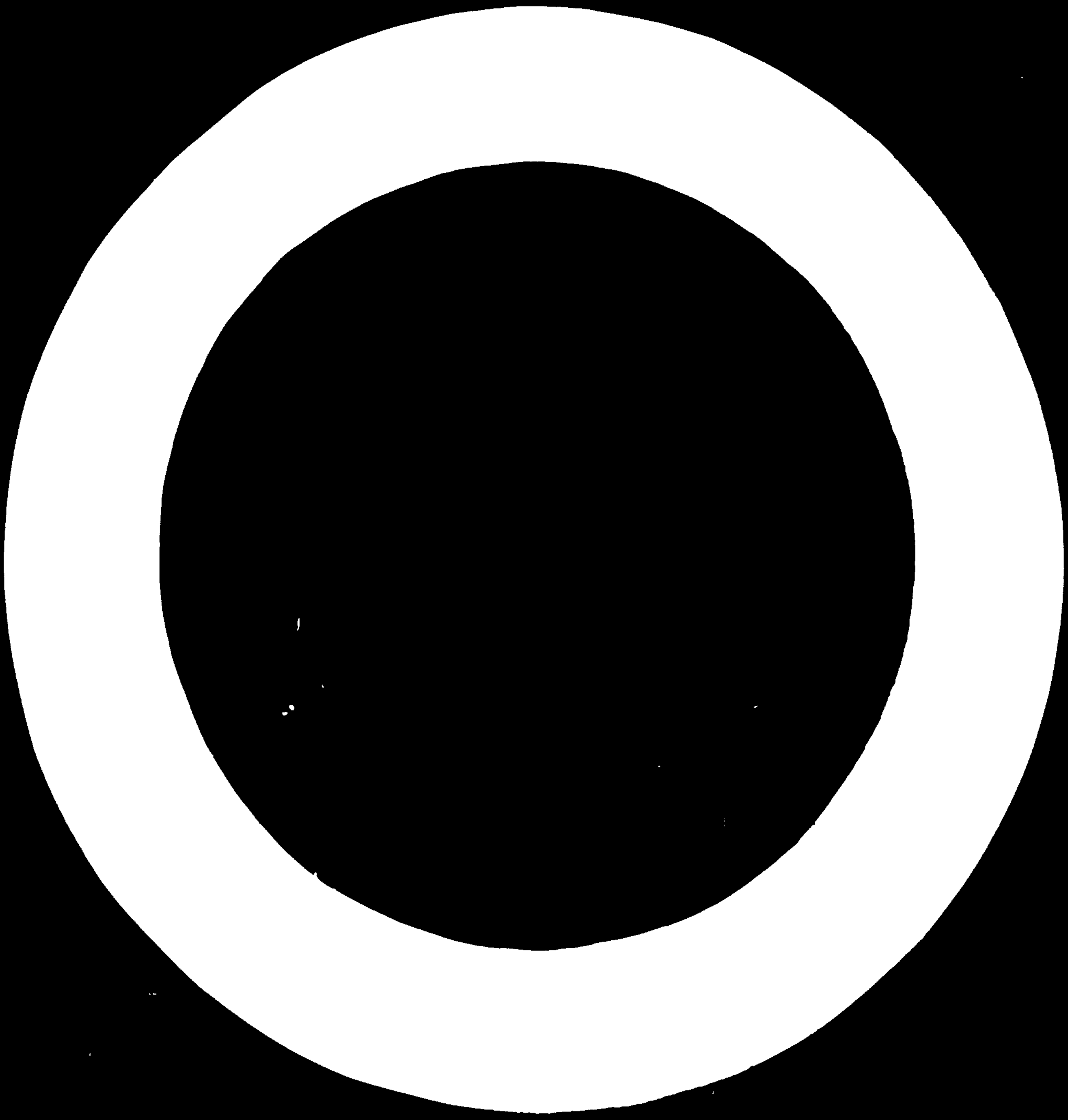
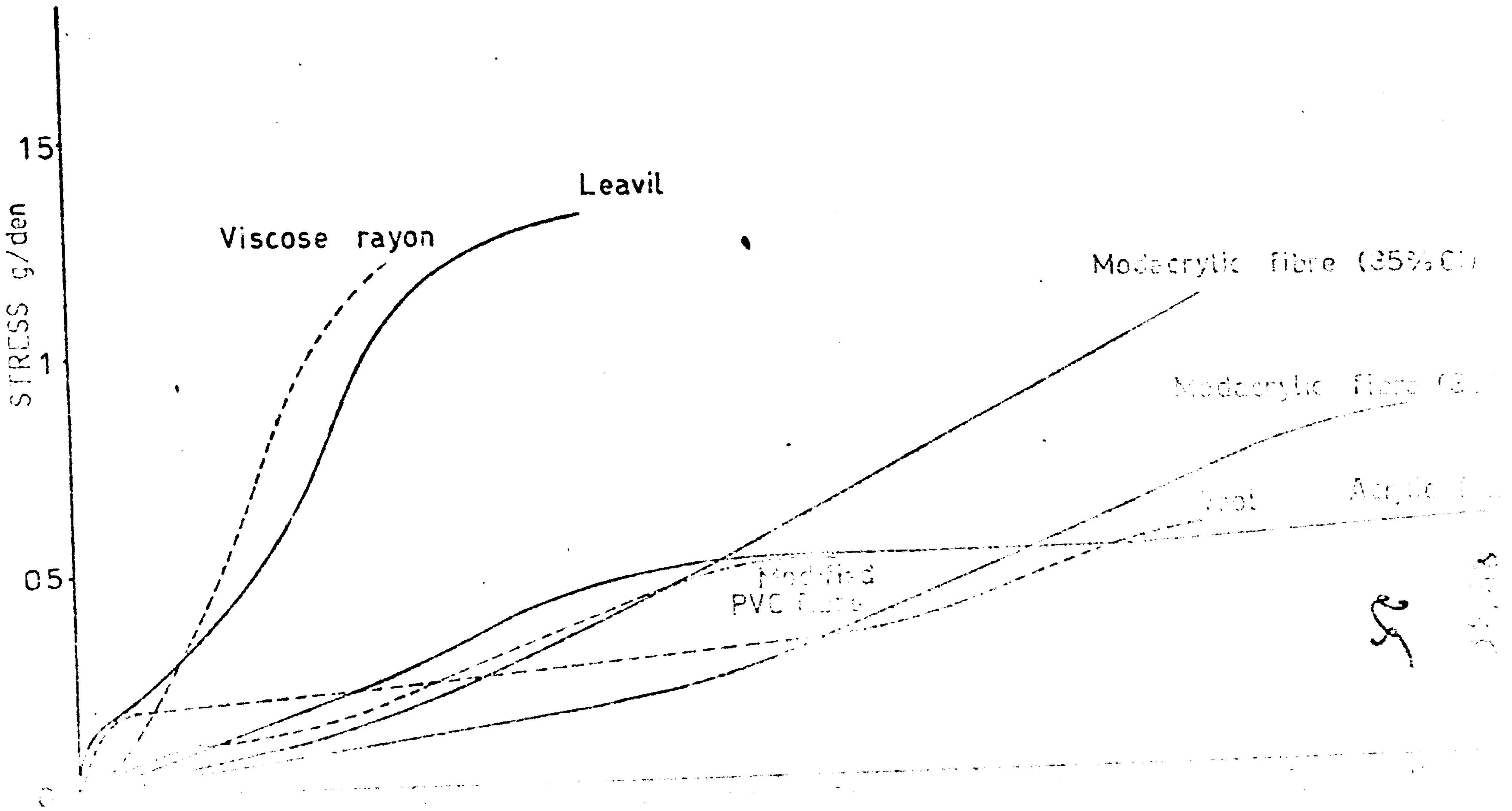
Fig. 8 - Properties of LEAVIL and other fibres under standard conditions and in water.

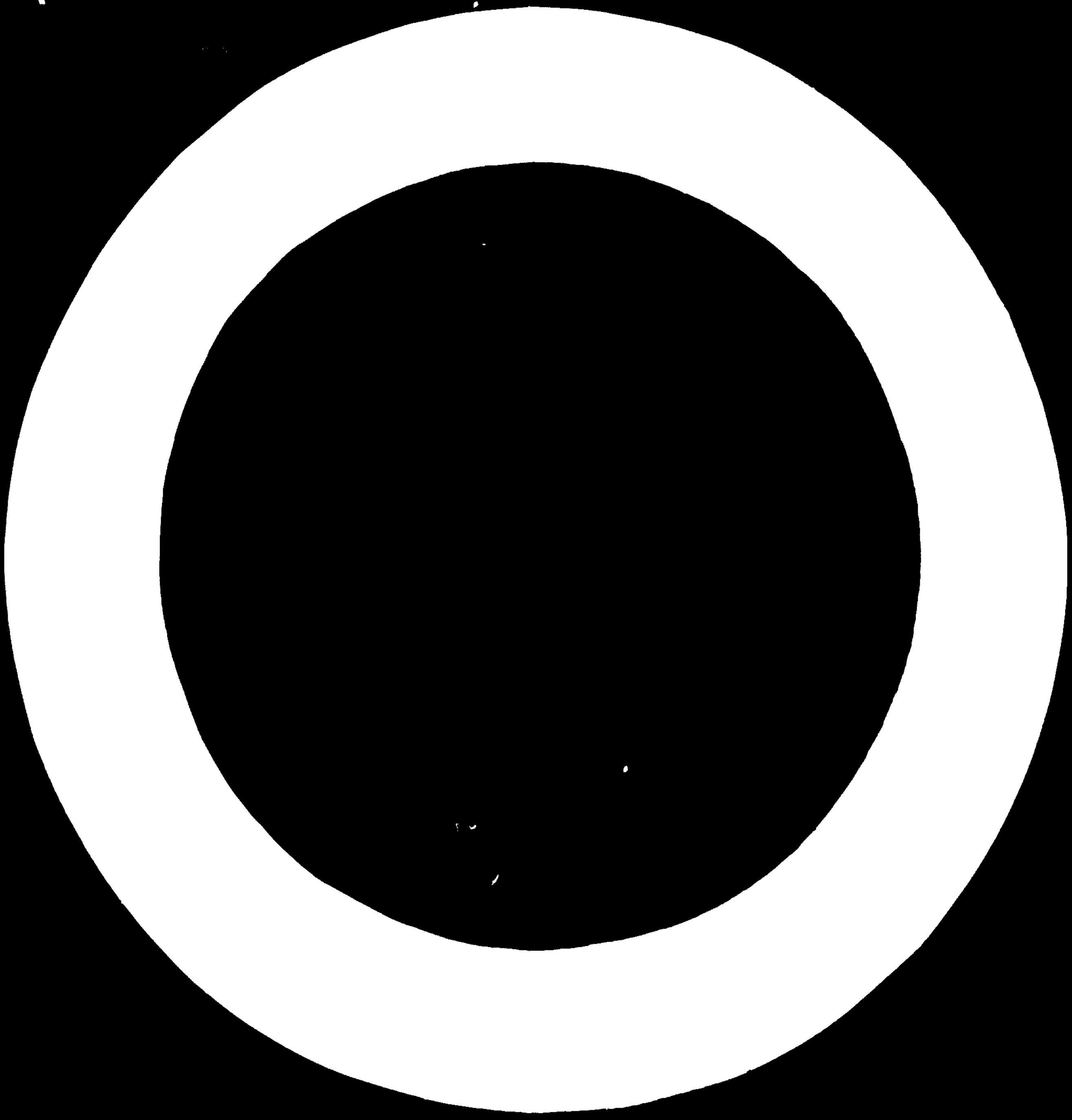
FIBRE	21°C, 65% R.H.		21°C in water		90°C in
	Tenacity g/den	Elong. %	Tenacity g/den	Elong. %	Tenacity g/den
Leavil	3.15	41	3.1	45	1.25
Traditional PVC fibre	2.5	24	2.3	27	shrinks
Pre-shrunk PVC fibre	1.7	105	1.6	105	shrinks
Modified PVC fibre	1.7	72	1.6	74	0.5
Modacrylic fibre (35% chlorine)	2.5	50	2.3	60	1.1
Modacrylic fibre (30% chlorine)	2.9	44	2.3	47	0.8
Acrylic fibre	2.4	43	1.8	46	0.6
Viscose rayon	2.5	18	1.4	24	1.2
Wool	1.3	39	1.2	57	0.5



STRESS STRAIN CURVES IN WATER AT 90 °C

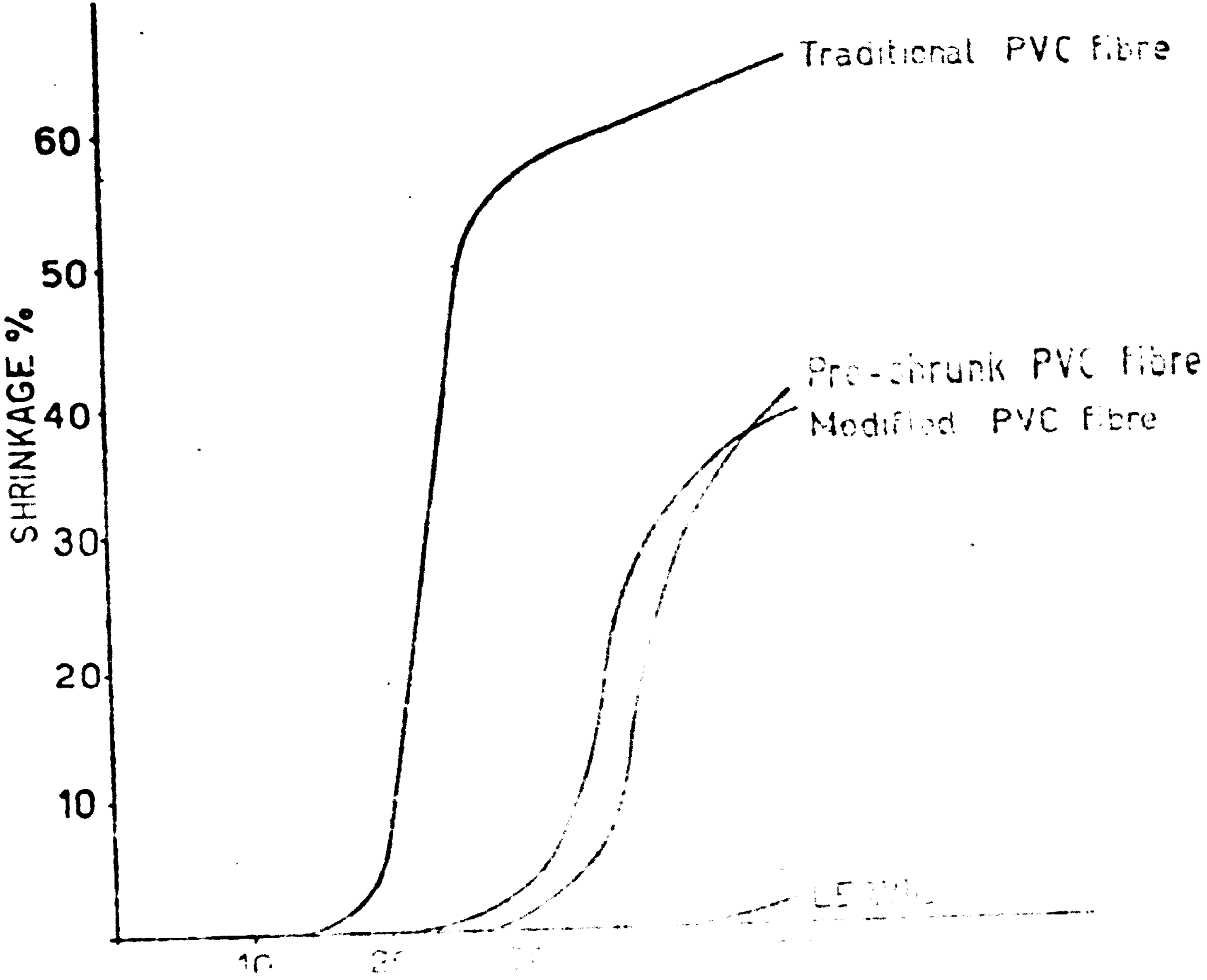
FIG. 9





DIMENSIONAL STABILITY OF PVC FIBRES IN TRICHLOROETHILENE

FIG.10



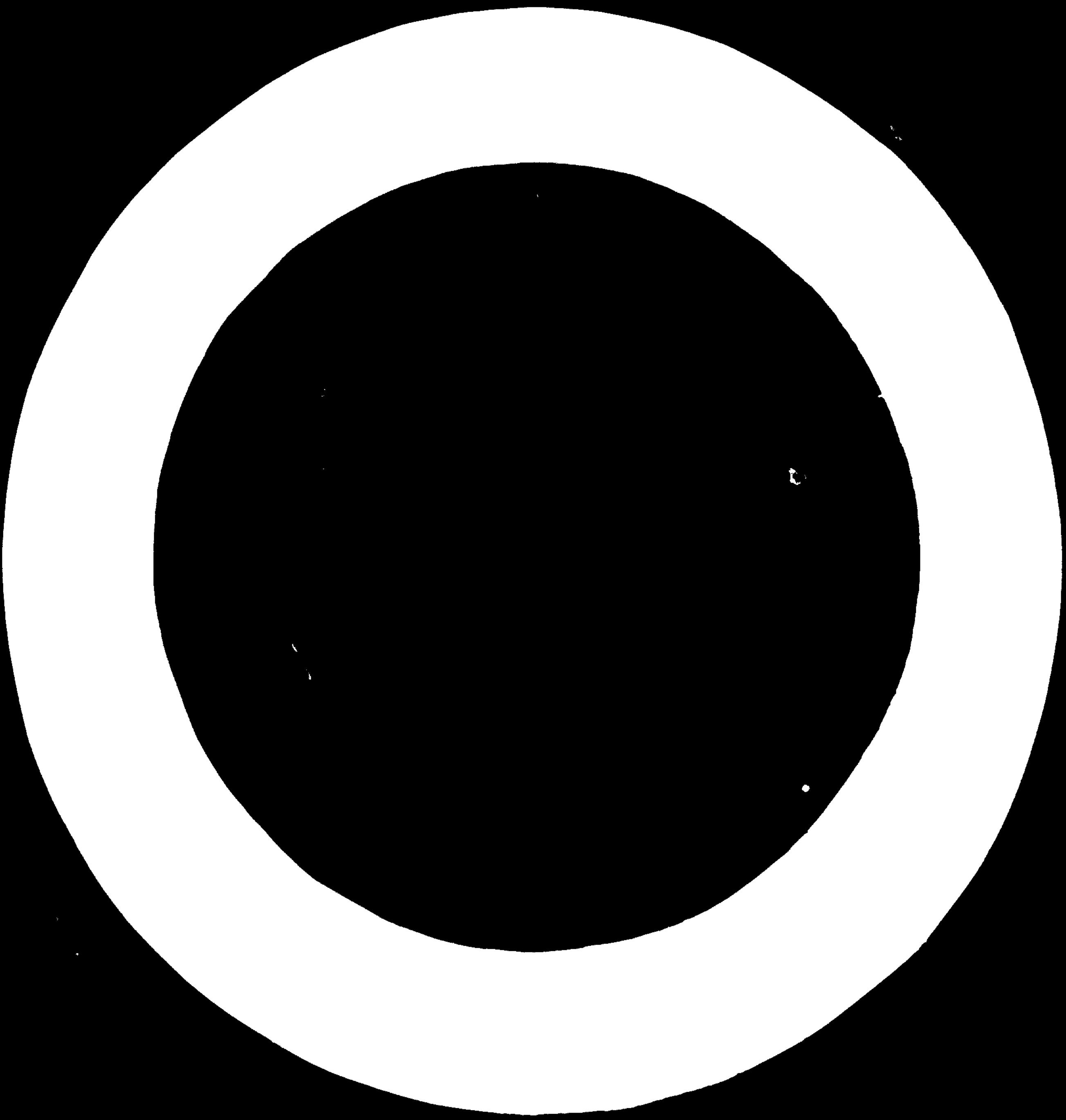


Fig. [illegible] [illegible] resistance [illegible] solvents

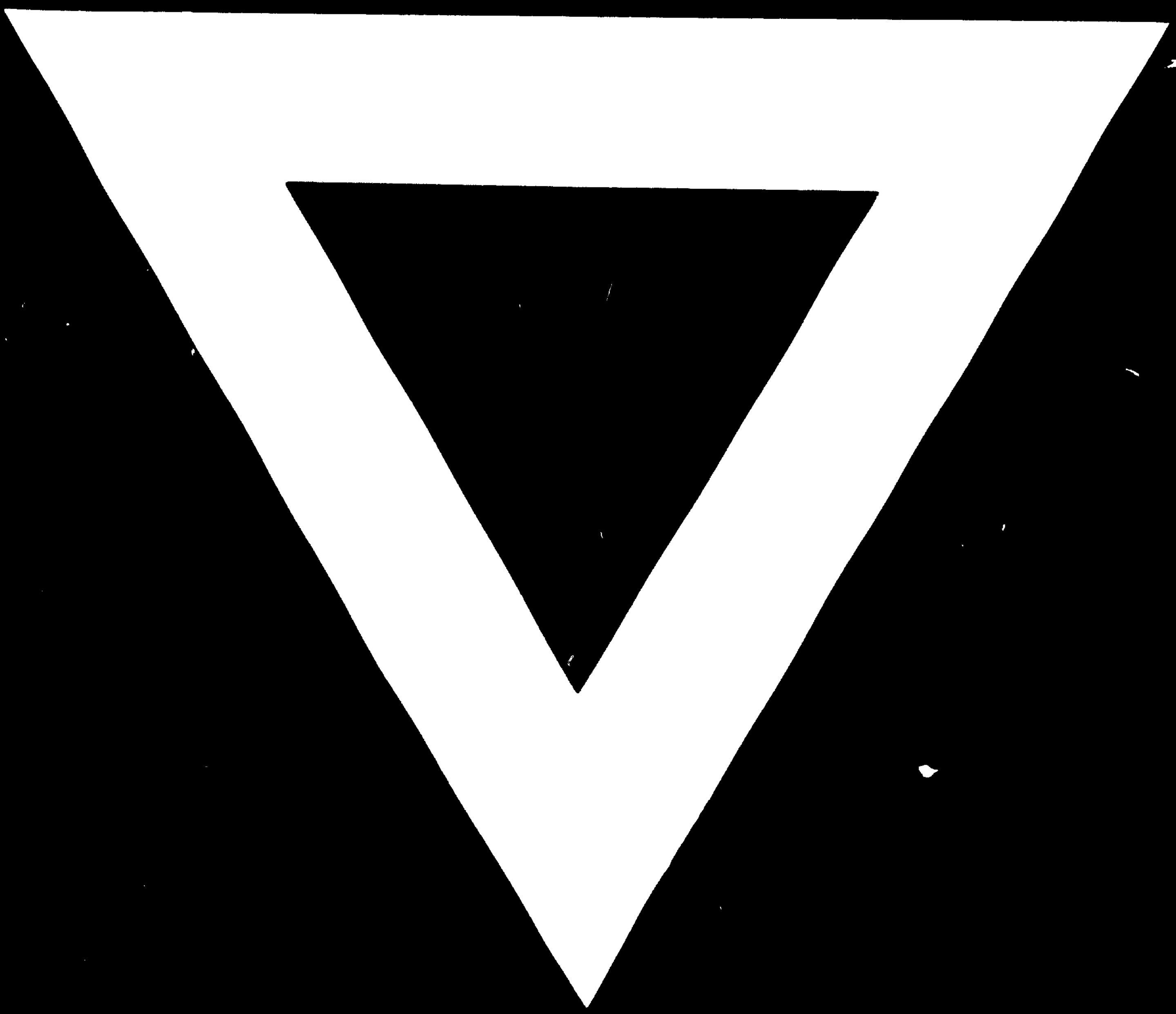
[illegible]	[illegible]	[illegible]	[illegible]
Formic acid	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]
Ethyl alcohol	[illegible]		[illegible]
[illegible]	[illegible]		[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Xylene	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
Trichloroethylene	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	

[illegible] other fibres' behaviour [illegible]

Fibre	[illegible]	[illegible]
[illegible]	[illegible] shrinks [illegible] swelling.	[illegible] Swells [illegible]
Traditional PVC fibre	[illegible]	[illegible]
Pre-shrunk PVC fibre	[illegible]	[illegible]
Modified PVC fibre	[illegible]	[illegible]
Modacrylic fibre [illegible]	Swells [illegible]	[illegible] Swells.
Modacrylic fibre [illegible]	Swells [illegible] 45%.	[illegible] swells.
Acrylic fibre	Unaffected.	[illegible]

Fig. 12 - Dispersed dyes selected for dyeing LEAVIL fibre

Acetoquinon Light Yellow [illegible]	(FRANCOLOR)
Artisil Yellow [illegible] Foron [illegible]	(SANDOZ)
Artisil Brilliant Yellow [illegible] Foron SE-6GFL	(SANDOZ)
Artisil Yellow [illegible] Foron SE-[illegible]	(SANDOZ)
Palanil Yellow 3G	(BASF)
Palanil Yellow [illegible]	(BASF)
Palanil Gold Yellow 2G	(BASF)
Samaron Yellow [illegible]	(HOECHST)
Samaron Brilliant Yellow [illegible]	(HOECHST)
Resolin Yellow [illegible]	(BAYER)
Resolin Yellow [illegible]	(BAYER)
Resolin Yellow [illegible]	(BAYER)
Setacyl Yellow P-[illegible]	(GEIGY)
Microsetile Yellow GT	(ACNA)
[illegible] Yellow [illegible]	(GEIGY)
[illegible] Brilliant Orange [illegible]	(GEIGY)
Cibacet Orange [illegible]	(CIBA)
Estrochile Light Orange 3RLL extra	(FRANCOLOR)
Estrochile Light Orange [illegible] extra	(FRANCOLOR)
Palanil Orange [illegible]	(BASF)
Samaron Orange [illegible]	(HOECHST)
Samaron Orange [illegible]	(HOECHST)
Samaron Brilliant Orange [illegible]	(HOECHST)
Acetoquinon Light Pink [illegible]	(FRANCOLOR)
Palanil Brilliant Pink [illegible]	(BASF)
Samaron Pink [illegible]	(HOECHST)
Foron Brilliant Red S-[illegible]	(SANDOZ)
Palanil Brilliant Red [illegible]	(BASF)
Palanil Red 3[illegible]	(BASF)
Foron Red [illegible]	(SANDOZ)
Foron Brilliant Red [illegible]	(SANDOZ)
Resolin Brilliant Red [illegible]	(BAYER)
Resolin Red [illegible]	(BAYER)
Resolin Scarlet 3GL	(BAYER)
Tersetile Rubine [illegible]	(ACNA)
Artisil Violet 2RFL Foron Brilliant [illegible]-2RFL	(SANDOZ)
Palanil Brilliant Violet [illegible]	(BASF)
Samaron Violet [illegible]	(HOECHST)
Resolin Red-Violet [illegible]	(BAYER)
Foron Brilliant Violet [illegible]	(SANDOZ)
Artisil Violet [illegible]	(SANDOZ)
Tersetile Violet [illegible]	(ACNA)
Estrequinon Light Blue [illegible]	(FRANCOLOR)
Foron Blue [illegible]	(SANDOZ)
Palanil Brilliant Blue [illegible]	(BASF)
Palanil Blue [illegible]	(BASF)
Palanil Blue [illegible]	(BASF)
Samaron Blue [illegible]	(HOECHST)
Samaron Blue [illegible]	(HOECHST)
Foron Dark Blue S-2RL	(SANDOZ)
Foron Navy Blue S-[illegible]	(SANDOZ)
Resolin Blue [illegible]	(BAYER)
Resolin Blue [illegible]	(BAYER)
Setacyl Blue P-RS	(GEIGY)
Setacyl Blue PS conc.	(GEIGY)
Microsetile Blue [illegible]	(ACNA)
Foron Yellow-Brown S-2RFL	(SANDOZ)
Palanil Yellow-Brown [illegible]	(BASF)
Tersetile Yellow-Brown [illegible]	(ACNA)
Tersetile Brown [illegible]	(ACNA)
Foron Brown S-3[illegible]	(SANDOZ)
Foron Brown S-[illegible]	(SANDOZ)
Foron Black S-[illegible]	(SANDOZ)
Foron Black S-[illegible]	(SANDOZ)
Tersetile Black [illegible]	(ACNA)



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