

STUDIES ON PHYSICAL PROPERTIES OF ALKYL CHLORIDE TREATED FLAX FIBRE

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ABSTRACT

Flax fibre was treated with alkyl chlorides and physical properties of treated fibres were studied. The results show that elongation increases with the increased size of the alkyl groups. Dodecyl chloride treated fibres exhibit significant improvement in extensibility (12.5%). Fibre strength decreases with the increase of reaction time as well as with the increased size of the alkyl groups. The fibre treated with higher alkyl chloride shows more moisture reduction.

INTRODUCTION

Flax under the genus *Linum Usitatissimum* of *Linaceae* family is a composite fibre and the main constituents of flax fibre are alpha cellulose (71.3%) and hemicellulose (18.5%). The lignin content of flax is 2.2% which is much less than jute (14.0%). The other constituents are pectin 2.0%, fats 4.3% and waxes 1.7%. Length of the ultimate flax fibre varies from 25 mm to 30 mm and diameter of 15 μ to 18 μ reported by ICSIR (1962).

Flax differs from other natural fibres such as jute, hemp, ramie etc by its low content of lignin. Like most other natural fibres flax absorbs moisture from surroundings due to presence of hydrophilic molecules.

Literature survey discloses that etherification of wood, cottonlinters, flax, hemp and other lignocellulosic materials with alkyl chlorides of carbon number from one to six ($C_1 - C_6$) by various workers (Nikitin and Orlova, 1933). In all cases, only pure cellulose in the form of chemical pulp or regenerated cellulose was used as the starting

materials. No attempt was made to study the properties of alkyl chlorides treated flax fibres. This paper deals with the treatment of flax with alkyl chlorides containing carbon atoms from $C_4 - C_{12}$ and the changes taken place in the fibre properties due to treatment.

MATERIALS AND METHODS

Flax fibre was collected from a local farmer in Mymensingh. It was manually cleaned and dried in the sun. Butyl, amyl, hexyl, heptyl, octyl, decyl and dodecyl chlorides were prepared from their respective alcohols by using thionyl chloride as described by Vogel (1956). Fibre was made alkali with sodium hydroxide solution of 20% (w/v) strength and then treated with alkyl chlorides at 30°C for different time periods as suggested by Lorand and Georgi (1937).

The elongation, bundle strength of the fibre conditioned for 24 hours in the standard atmosphere (65 \pm 2% RH; 20 \pm 2°C temperature) were determined by stelometer according to ASTM (1966).

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Table 1 Percent elongation, bundle strength and moisture regain of flax fibre during different treatments.

Treatment with	Time of treatment (hours)	Elongation (%)	Bundle strength (g/Tex)	Moisture regain (%)
Butyl Chloride	Control	2.25	13.65	6.89
	1	11.50	10.45	5.20
	2	11.30	10.50	5.00
	4	11.25	10.30	4.80
	8	10.85	9.85	4.75
	24	9.65	9.40	4.65
Amyl Chloride	Control	2.25	13.65	6.89
	1	11.70	10.00	5.00
	2	11.55	10.20	4.95
	4	11.45	10.30	4.70
	8	11.00	9.60	4.50
	24	10.85	9.00	4.45
Hexyl Chloride	Control	2.25	13.65	6.89
	1	11.75	9.75	4.90
	2	11.65	10.15	4.85
	4	11.45	9.70	4.60
	8	11.15	9.45	4.45
	24	10.90	8.90	4.40
Heptyl Chloride	Control	2.25	13.65	6.89
	1	11.80	9.85	4.80
	2	11.70	10.20	4.75
	4	11.50	9.68	4.55
	8	11.10	9.25	4.40
	24	10.95	8.60	4.35
Octyl Chloride	Control	2.25	13.65	6.89
	1	11.95	9.80	4.80
	2	11.65	10.00	4.70
	4	11.50	9.65	4.40
	8	11.20	9.00	4.35
	24	11.00	8.50	4.00
Decyl Chloride	Control	2.25	13.65	6.89
	1	12.00	9.00	4.50
	2	11.80	8.90	4.45
	4	11.00	8.68	4.30
	8	10.50	8.55	4.20
	24	9.00	8.40	3.90
Dodecyle Chloride	Control	2.25	13.65	6.89
	1	14.50	8.50	4.25
	2	14.00	8.25	4.20
	4	13.50	7.85	4.00
	8	12.80	7.60	3.85
	24	11.50	7.32	3.60

The flax fibre was dried at 105°C to constant weight and exposed to standard atmosphere for 48 hours and weighed again carefully in the conditioned atmosphere. The percent elongation was calculated according to Macmillan and Mukherjee (1950).

RESULTS AND DISCUSSION

Flax fibre was made alkali with 20% sodium hydroxide and then treated with alkyl chlorides for different times at 30°C. The percent elongation, bundle strength and moisture regain of treated fibres were determined. The results are shown in Table 1. It is seen from the results that the percent elongation or extensibility of the treated flax fibre increases with the increased size of the alkyl groups and decreases with the increase of reaction time. A significant improvement in extensibility (12.5%) has been achieved with dodecyl chloride treatment of flax. The percent elongation of flax fibre is much higher than that of dodecyl chloride treated jute fibre (9%) reported earlier by Rahman (1989). The increase in elongation is perhaps due to swelling effect of alkali as well as the introduction of bulky alkyl groups which weaken inter connecting hydrogen bonds in adjacent regions.

It is observed from the results that bundle strength of alkyl chloride treated flax fibre is less compared to the control (13.65 g/Tex). The fall in strength of flax fibre follows the same pattern as that of jute previously reported by Rahman (1989). It falls gradually as the size of the alkyl groups increases and also with progress of the reaction time. The removal of lignin and hemicellulose from flax and the bulky alkyl groups introduced are the causes for the fall of bundle strength.

The size of the hydrocarbon parts of alkyl chlorides plays an important role on water repellency. It is revealed from the results that as the size of the alkyl radical increases moisture absorption decreases. Dodecyl chloride treated flax fibre exhibit maximum water repelling property which is in confirmity with, the previous results obtained from dodecyl chloride treated jute fibre reported by Rahman (1989).

It appears from the foregoing discussion that alkyl chloride especially dodecyl chloride treatment of flax improves the quality of the fibre. Chemically modified flax fibre may be mechanically spun into fine quality yarn. It may be used for making apparels, shopping bags and many other domestic materials. It may find specialized application in combination with plastic materials such as polyvinyl chloride, polyethylene films and as a reinforcement for polyester resins. Flax fibre by itself and/or in admixture with other natural or synthetic materials may be used for making canvas, aprons, blankets, jute flux union for tropical suiting, luggage covers, etc. The blending of cotton and other synthetic fibres with modified flax may help to improve textile properties of the products; this will thus help to grow more textile industries in our country.

CONCLUSION

Alkyl chloride treated flax fibre has little effect on fibre strength, but a significant improvement in extensibility and water repelling property has been achieved. These properties may help making a good yarn of immense textile value.

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