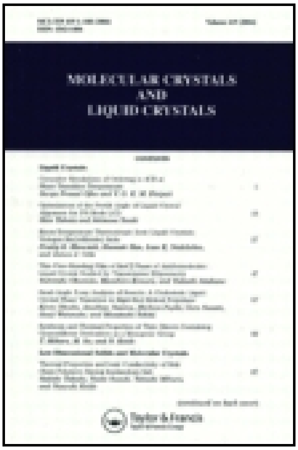

Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl19

Micro — and Nano—Cellulosic Fibres

Bogumił Łaszkiewicz [a]

[a] Technical University of Łódź, Żeromskiego 116, 90-543, Łxódź, Poland

Version of record first published: 24 Sep 2006

To cite this article: Bogumił Łaszkiewicz (2000): Micro — and Nano—Cellulosic Fibres, Molecular Crystals and Liquid Crystals Science and Technology. Section A. Molecular Crystals and Liquid Crystals, 353:1, 271-274

To link to this article: http://dx.doi.org/10.1080/10587250008025666

Mol. Cryst. and Liq. Cryst., 2000, Vol. 353, pp. 271-274
Reprints available directly from the publisher
Photocopying permitted by license only

Micro – and Nano–Cellulosic Fibres

BOGUMIŁ ŁASZKIEWICZ

Technical University of Łódź, Żeromskiego 116, 90–543 Łódź, Poland

Conditions of micro- and nanofibres preparation was reported. In this paper was presented global situation in the textile industry and its restructurization. As a result of the movment in textile industry many companies and research centers started to prepare new technologies for new fibres with special properties. One of this direction are research works on special micro-and nanofibres.

Keywords: cellulose; fibres; micro and nanofibres

INTRODUCTION

In last year global restructuring in the fibre industry was observed as a effect of the strong growth of synthetic fibre capacities in the 3-4 year before, particularly in the Far East, led to difficulties in the textile industry with a strong decline of price. The largest fibre producers in the worl changes their interest and start to develop into Life Science businesses including agricultural products, pharmaceuticals and biotechnology[1]. In the same time the largest producers of cellulosic fibres e.g. Lenzing, Courtaulds and Akzo Nobel started to cooperate closely on development of the Lyocell fibres, staple and filament. Similar concentration of interest is observe in the textile science and research. In the USA the National Textile Center, is set up a university research consortium including Anburn University, Clemson University, Georgia Institute of Technology and North Carolina State University,with an annual budget of from $ 7 to $ 9 million per year. In the European Community 5-th Research Program was established which will be stimulated development of new technologyes in different areas of science and industry. Similar, in Japan scientific and research programme of Shin-Goshen is in continuation.

As the effect of the above strategic movement many new fibres, with new properties were introduced to the industry and on the market e.g. super fine fibres, synthetic microfibres, fibres with special properties: semi-conductors, sensors, photo- and thermochromic, and others.

Many different kind of fibres on the market make necessity to introduce classification based on its thickness, e.g.

- ordinary fibres for textiles having a thickness of 1-9 dtex, mostly 1.7-7.0 dtex
- fine denier fibres having a thickness of 0.4 - 1.0 dtex
- microfibres having a thickness of less than 0.3 dtex, mostly 0.1 - 0.3 dtex
- nanofibres having a thickness of less than 0.1 dtex.

Above classification can be expressed in drawing form as belove.

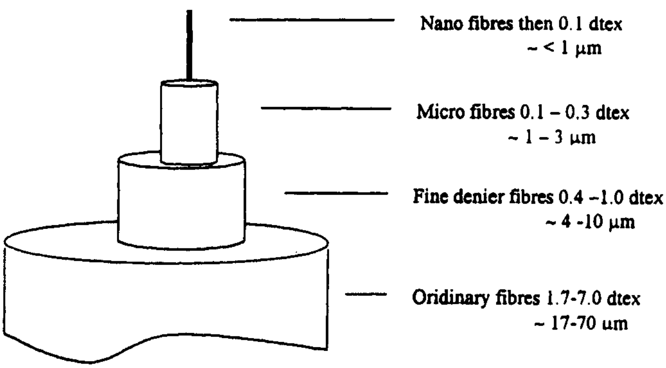

FIGURE 1 Classification of the fibres based on its thickness

MICRO AND NANO-CELLULOSIC FIBRES

In last decade production of the fine denier fibres and microfibres sharply increase, mainly in Japan and USA [2]. Fine denier fibres of the continuous-filament type is produced by a variety of methods, including direct spinning and conjugate spinning, but staple type are produced by melt-blowing or jet spinning, centrifugal spinning, polymer-blend spinning, fibrilation or violent flexing, flash-spinning, bursting and by turbulent flow-moulding.

Prospects for the fine demier fibre application is very wide e.g. wiping cloths, dust-absorbing cloths, filters, separators for electric cells, high-touch clothing, suide-like materials, water-absorbing or oil-absorbing material bloodcell separators, enzyme holders and many others.

For preparation of the fine denier fibres and microfibers are used conventional fibre forming polymers e.g. polypropylene, polyamide 6 or polyamide 66 and polyethylenoterephtalate.

According to the Griffith[3] equation:

$$\frac{1}{\delta} = \frac{1}{\delta_{theo}} + K \cdot FLD^{0.25}$$

where: δ - experimental filament tenacity

δ_{theo} - tenacity of a flowless filament

K - constant

FLD - filament linear density

can be draw dependence of filament tenacity versus filament linear density as below.

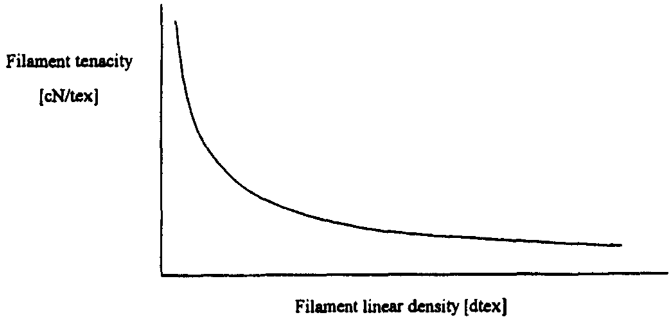

FIGURE 2 Filament tenacity vs. filament linear density.

Above Griffith's equation shown that the filament tenacity increase with lowering of the filament linear density. These dependence was fully receipt in our research[5]. Therefore, is clear that microfibres can be applied to the technical fabrics where high tenacity is require. Similar dependence can be observe for nanofibres, which will be in preparation in the nearest future. In this case NMMO proces for preparation of cellulosic fibres is very useful, particularly for spinning of the micro- and nanofibres. This affirmation arises from a few factors:

- cellulose solutions with NMMO has lyotropic properties
- solutions of cellulose in NMMO has very good spinability in wide range of polymer concentration
- NMMO as direct solvent for cellulose dissolve this polymer with very high molecular weight
- cellulose as fibre - forming polymer can by obtained with very low molecular distribution.

A few methods can by applied for preparation of the micro- and nanocellulosic fibres, e.g. composite spinning, pneumothermal spinning, air gap spinning with funnel wet coagulation, flash spinning or ultra-centrifugal spinning.

CONCLUSION

Based on our research experiments the best method for preparation of the micro- and nanocellulosic fibres is ultra-centrifugal spinning or pneumothermal spinning.

References

[1] A.J. Koslowski, *Chem. Fibers Int.* **48,** June 174 (1998).

[2] M. Matsui, Man-Made Fiber Year Book (CTI) p. 20 (1993).

[3] J.P. Penning, A.A. de Vries, J. Van der Ven, A.J. Pennings, H.W. Hoogstraten, *Phil. MaG.a.,* **69** (2), 267 (1994).

[4] T. Nakajima, Advanded Fiber Spinning Technology, England 1996.

[5] B. Łaszkiewicz, Z. Lewandowski, Pol. Pat. 168 034.