Cellulose

This Factsheet gives an overview of the current and potential market for cellulose

Markets

Current Applications

Cellulose is used in a number of high value markets. When used to make industrial products, cellulose typically contains more than 90% alpha cellulose - a highly refined, insoluble cellulose where sugars, pectin, and other soluble materials have been removed. This cellulose is known as dissolving pulp.

There is considerable variation in the quality of dissolving pulp and this determines the suitability for different end markets. Cellulose used to make 'regenerated' fibres, such as rayon and cellophane, typically contains 90-92%[1] alpha cellulose. In contrast, production of cellulose esters, such as cellulose acetates used in some film, packaging and tow applications, is more sensitive to contaminants and requires higher cellulose purity (at least 95-96%)[1].

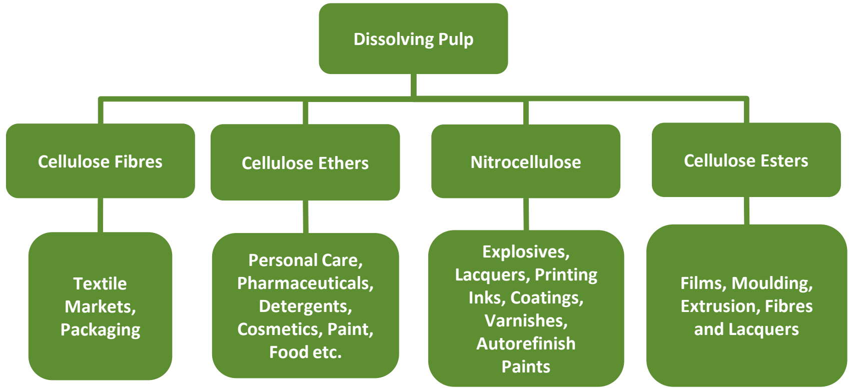
Current Production

Worldwide, 3.6 million tonnes of dissolving pulp was produced in 2009[2]. The production of dissolving pulp increased by 24% worldwide between 1998 and 2009[2]. In the same period, European dissolving pulp production increased by 82%, from 520,000 tonnes in 1998 to 950,000 tonnes in 2009[2]. Production also increased elsewhere in the world, for example, Asian production increased by 27% and African production increased by 19%, though the production increase in the Americas was only just over 1%[2].

Current Demand

Approximately 33% of dissolving pulp is used for derivative markets, such as esters and ethers, with 66% used in regenerated cellulose markets[3]. The market for cellulose products is buoyant, with increasing demand for fibres in Asia resulting on knock on effects in other cellulose markets[4]. As a result dissolving pulp is in short supply and is highly priced. In May 2011, dissolving pulp was being traded on spot markets at $2,200 per tonne (£1,344)[5].

Cellulose ether markets are currently valued at $82 million, and expected to reach $115.4 million by 2015[6]. Acetate tow (cellulose esters) markets are expected to increase 1-2% per year to 2015, increasing from an estimated 760,000 tonnes in 2010 to 840-850,000 tonnes[7].



- Global Production: ~3.6 million tonnes per year
- Current Market Price: $1,344 per tonne (May 2011)
- Renewable Capacity: ~3.6 million tonnes per year
- Renewable Technology Status: Commercial
- Major Current Use: Chemical & polymer applications

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Image courtesy of Dupont

Current Production Route from Biomass

Dissolving pulp is principally derived from sulphite or modified kraft pulping (pre-hydrolysis) processes. Pulps are treated to remove hemicelluloses to leave a highly pure cellulose known as dissolving pulp. A variety of hard and softwood species are used for dissolving pulp production including ash, beech and eucalyptus, although highly resinous species are less suitable. The yield of dissolving pulp is around 35%[8].

Environmental Sustainability Benefits

A new process for the production of dissolving pulp from paper grade pulp has been developed by Finnish and Estonian researchers. This process has been in commercial production in Finland since the beginning of 2011[5,9] and overcomes the need to use limited and highly priced dissolving pulp for the production of regenerated cellulose products, such as viscose[5].

There are two technologies which could potentially produce high quality cellulose for industrial uses although neither are commercial at present. These are biomass fractionation and the production of cellulose in bacteria.

Biomass fractionation processes split biomass into three distinct fractions; lignin, cellulose and hemicelluloses. The process recovers 90-95% of the biomass at a purity of around 95%[10]. The quality of cellulose derived from biomass fractionation is similar to that obtained from the dissolving pulp markets, especially if it includes a bleaching step[10].

Cellulose may be isolated from bacteria, such as *Acetobacter xylinum*, through fermentation. Bacterial cellulose is free of both lignin and hemicelluloses and has a high degree of polymerisation[11]. However, the current low yields and high costs of this technology are barriers to large scale deployment[11].

Manufacturers

Borregaard: www.borregaard.com

Buckeye: www.bkitech.com

Rayonier: www.rayonier.com

SAPPI: www.sappi.com

Tembec: www.tembec.com

Weyerhaeuser: www.weyerhaeuser.com

Potential Market Developments

With increasing oil and cotton prices, and growing preference for bio-based products, especially those derived from non-food materials, markets for dissolving pulp are well placed to grow in the future.

The cellulose film and fibre industries are increasingly focussing on the development of materials with enhanced performance compared to their existing product ranges. For example, using cellulose fibres in conjunction with other plant fibres in order to develop high value composite materials.

References and Further Reading

1 Durbak, I. (1993) Dissolving Pulp Industry Market Trends. USDA. www.fpl.fs.fed.us/documnts/fplgtr/fplgtr77.pdf

2 FAOStat (2011) Forestat. http://faostat.fao.org/site/626/default.aspx#ancor

3 Jering, A. and Gunther, J. (2010) Use of renewable raw materials with special interest on chemical industry. European Environment Agency.

4 Heller, L. (2010) Food Navigator. www.foodnavigator-usa.com/Financial-Industry/Food-firms-face-more-cellulose-price-increases

5 Hilman, D. (2011) A First: Converting Paper Grade Pulp into High Purity Dissolving Pulp. GLG Research www.glgroup.com/News/A-First--Converting-Paper-Grade-Pulp-Into-High-Purity-Dissolving-Pulp-54056.html

6 Pitman, S. (2007) Cosmetics Design Europe. www.cosmeticsdesign-europe.com/Formulation-Science/Market-for-cellulose-ether-hots-up-in-Europe

7 Lerner, I. (2010) Smoking growth supports acetate. ICIS Chemical Business.

8 Woodings, C. (2001) Current and Future Market Trends in Regenerated Cellulose Fibres. Woodhead Publishing Ltd.

9 Eisberg, N. (2011) New Route to Viscose. Chemistry and Industry.

10 NNFCC (2009) Marketing Study for Biomass Treatment Technology www.northeastbiofuels.com/_assets/file/marketingstudynnfcc.pdf

11 EU, ESTO and IPTS (2004) Techno-Economic Feasibility of Large Scale Production of Bio-based Plastics in Europe. Wolf, O. (ed). http://ftp.jrc.es/EURdoc/eur22103en.pdf