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Chemicals, Deinking, Patent, Recycling, Review, Stickies, Waste paper.

INTRODUCTION

This review summarizes patents related to paper recycling which first appeared during the second half of 1997 in either of two on-line data bases: Derwent World Patent Index and Claims/US. Patents Abstracts. This review is intended to keep readers apprised of recent trends and developments in recycling technology. The abstracts give only minimal information about the inventions, For more detailed information, readers will need to obtain the full texts of specific patents.

The patents cover a broad spectrum of recycling processes and products. They've been grouped into the broad categories of Deinking, Sorting, Processes, and Products.

DEINKING

As with, our review for the first half of 1997, deinking was the most popular topic for patents during the second six months of 1997. It is the subject of two dozen patents.

The Kao Corporation has registered two patents. The fist 111 is for high temperature (40-80 deg. C.) deinking, using an alkylene oxide adduct, which is said to produce pulp with excellent qualities from mixtures of waste magazines and newspapers in ratios of 5/95 to 60/40. The second [2] is for a deinking agent with a polyoxyalkylene group and for a process which uses this agent.

Kabushiki Kaisha Taizen [3] has a mechanical process which deinks waste paper using three cylinders to apply gradual pressure. At least the first of the three cylinders has an inner cylinder with numerous small holes; this permits active removal and discharge of water. Each cylinder has a rotating shaft to which is attached a group of blades at crossing angles.

Owen has two patents, one US [4] and one British [5], in which deinking is by magnetic forces. The technique is particularly useful for laser and xerographic papers, where the ink contains ferric oxide. The method removes the ink by capture or deflection from pulp slurry which is 4% or less by weight. Shell Chemical [6] deinks these papers by chemical means, using an alcohol ethoxy-carboxylate agent.

Geo Specialty Chemicals have three patents. The first two are for deinking chemicals: an alkoxylated lanolin derivative which contains 55-80% ethylene oxide and 15-30% propylene oxide [7] and an ethoxylated soya glyceride with glycols [8]. The third [9] is for a washing method in which an alkoxylated nonionic surfactant is added to the recovered paper slurry, followed by washing and separation.

Ahlstrom Machinery Oy [10] has developed a deinking system which uses a foam separation vessel into which slurry is introduced from several gas-charged hydrocyclones. Ink is removed by the swirling action and air contact.

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PPG Industries [11] presents a flotation system for removing electrostatic ink and/or stickies and, optionally, conventional impact inks. The patent includes specific deinking chemicals and nonionic surfactant additives. The latter include capped aliphatic and alicyclic alkoxylates, alky phenol ethoxylates, and combinations of the two.

BetzDearborn Inc. [12] has patented a process which comprises (a) an alcohol, randomly alkoxylated with a mixture of alkylene oxides, for a surfactant, (b) a thiol ethoxylate surfactant, and (c) a secondary alcohol alkoxylate. The surfactant is said to enhance the aggregation of electrostatic toner particles.

Papiertechnische Stiftung [13] designed a system which deinks by aeration and centrifugal forces. They claim that the centrifugal forces accelerate the separation and reduce the required size of the flotation device.

Chen [14] has patented a powdered deinking agent which consists of anhydrous sodium sulphate, talc powder, sodium silicate, soap powder, surfactant, and sodium carbonate. Because the agent is a powder, it is said to be convenient for application and transportation, thereby lowering the cost of deinking.

BASF [15] has patented water-soluble polymers with a variety of uses, including deinking of waste paper. The advantages claimed for these polymers are that they can be produced in a one-stage reaction and that they are absorbed by activated sludge in biological sewage treatment plants so that elimination is greater than 90%.

The Lion Corp. has patented two deinking agents. The first [16] comprises an enzyme and polyether; the second [17] is an alkylene oxide compound used in a flotation process. Both patents claim high brightness and low residual ink in the recovered pulp.

Bim Kemi AB [18] has designed a flotation system which comprises a surface active ester as the deinker and a polyester-based collector for aggregating the ink particles. The chemical system is said to be cost effective and environmentally friendly for deinking at lower pH than current methods.

Gonzalez [19] has a new deinking product which is a mixture of trisodium phosphate, sodium carbonate, sodium salt of methyltaurid based on fatty acids, and sodium percarbonate. The mixture is used in a single treatment of the pulp and is said to avoid the drawbacks of traditional multi-stage methods.

Nippon Gosei Gomu KK [20] presents an agent containing a water-soluble immobilized enzyme. It is said to provide a high level of ink removal and high yield of pulp.

Hokkai Can Co. [21] has developed a compact machine for removing both conventional and magnetic inks. It comprises a pulp solution storage tank (where deinking agents are introduced), a mixing unit, and an aeration unit.

Morton Int. [22] uses an aqueous composition containing a sodium hydrosulphite agent for deinking recycled pulps, especially newsprint. It is claimed to be cheaper than conventional oxidative processes and to produce superior brightness.

Li and Wang [23] have developed a high-concentration process which is said to have the advantages of low power consumption, high efficiency, and low cost. It comprises (a) mixing water and the deinker in a rotary metallic container, (b) adding the recovered paper and rotating for 1 to 2-1/2 hours, and (c) discharging and washing.

Rhone-Poulenc Inc. [24] uses a nonionic surfactant which simultaneously deinks and reduces the ash content of flexographically printed papers, newsprint, paperboards and, especially, mixed office papers. First, a slurry of paper pulp and surfactant is formed, and the slurry is subsequently treated in a flotation cell. Additional chemicals may be incorporated in either step.

SORTING

The sorting of mixed wastes is the subject of seven patents.

In their patent, World Environmental Systems [25] discloses a method and apparatus in which the waste material is sorted, centrifugally milled, and magnetically separated to produce multiple recyclable recovered products..

Jongebloed [26] has patented the design for a large-scale multi-acre facility for sorting recovered mixed paper. The facility includes sorting by mechanical, manual, and x-ray methods on a series of conveyors.

Two patents address the mechanical separation of mixed municipal wastes. Biomass Recycling [27] uses a carrier which accelerates and decelerates and thus separates items by their "physical properties, particularly the coefficient of friction." Eastern Power Ltd. [28] uses an inclined rotating cylindrical drum with perforated side wall and a flow of gas to separate by size and density

'Iwo patents propose electrostatic sorting of domestic wastes. Era Patents [29] has an apparatus which comprises an electrically conductive platform and an electrode which applies a high voltage to sort articles "depending on their mass and electrical properties." NEC Corp. [30] adds a dissolution liquid of an electrolyte into a mixture of recovered paper and plastic and performs electrostatic separation.

Obermueller and Obermueller [31] remove foreign objects from recycled paper pulp by radiation sensors which detect the objects' "different, unique and measurable physical characteristics" and then "operate a discharge arrangement located downstream..." They claim to be able to remove objects, such as small pieces of plastic, which cannot otherwise be detected.

PROCESSES

Various recycling processes are described in a dozen new patents.

Westvaco Corporation [32] has patented a method for reducing the aluminum content of recycled pulp and paper prior to digestion.

International Paper Co. [33] improves the brightness and cleanliness of secondary fibers by adding a high level of calcium carbonate to the pulp, mixing with an alkaline salt such as calcium oxide or calcium hydroxide and contacting with a reaction gas such as carbon dioxide. This precipitates filler material, such as calcium carbonate crystal complexes, onto the fibers.

ECC International [34] has a process for recovering inorganic material from recycled paper effluent. First, organic material is removed by oxidation at high temperature and high pressure. Then, water containing fine carbon particles is separated from the resulting product leaving the desired inorganic material.

Nippon Seishi [35] produces medium- or low-grade paper by mixing mechanical pulp, deinked pulp, and a filler. To this mixture are added an electrolytic cationic polymer, an anionic polymer, and bentonite. The advantage cited is that the process can be carried out in neutral or alkaline (pH 6-10) conditions.

Wang [36] patented a multi-step process for treating and recirculating paper-making waste water. It comprises physical-chemical pretreating to separate straw pulp, acid-alkali separation and decoloring, and features which reclaim straw pulp, lignin, and caustic soda from the waste water. Benefits claimed are reuse of the treated water, no secondary pollution, computerized monitoring, and low cost.

Mitsubishi Paper Mills [37] treats recovered paper for recycling by maceration, deinking, and bleaching. They treat the paper with an enzyme having an alkali lipase. They claim efficient removal of ink, stickies, and colorants.

Voith Sulzer Stoffaufbereitung has patented two processes. In the first [38], they use high-temperature intense refining and pressurized bleaching to deink and recover fibers from printed waste. In the second [39], they enhance the whiteness of pulp, especially from recovered paper, by adding bleach to compressed pulp in a dispersion machine.

Alpha Calcit Fuellstoff [40] patented a method for recovering fillers and coating pigments from coating line effluent, deinking plants, in-house water treatment plants, or separation devices. It comprises mixing and grinding the sludge with fresh pigment or filler powder. The recovered material is used in the manufacture of new coatings.

Kemira Chem Oy [41] has developed a high-yield process for bleaching mechanical pulps which may include recycled fibers. The pulp is pretreated with a biodegradable chelating agent to remove heavy metals.

Pellerin Milnor Corp. [42] has a method for recycling printed papers, especially electrostatically-printed material. They treat the fibers with deinking/agglomeration chemicals, agitate in a rotating perforated drum and then wash the pulp in a second drum.

Valtion Teknillinen Tutkimuskeskus [43] has a method which would add chemical markers, consisting of metal tracer elements, to pulp. The markers would indicate the number of times the pulp has been recycled and thus allow it to be sorted for appropriate reuses.

PRODUCTS

Two patents have been issued for soft, absorbent, tissue products, such as toilet paper, napkins, etc., made from CTMP (chemi-thermo-mechanical pulp) or recycled pulp. These are by Proctor & Gamble [44] and SCA Hygiene Paper [45].

Arota KK [46] has a patent for regenerated writing paper and a treating agent and process for manufacturing the paper. The paper may comprise synthetic fiber, chemical fiber, inorganic fiber, leather fiber, bast fiber, cellulose fiber, wood pulp, and vegetable fiber.

DRP GMBH Direkt Recycelte Papierprodukte [47] has patented paper products, such as carrier bags, writing pads, paper bags, document covers, tablecloths, etc. that are cut-out or stamped-out sections of recycled paper. The paper is prepared or pretreated without the use of chemical additives or water.

The Shimadu Corporation and Tomoegawa Paper Co. [48] have patented a toner and a method for its production. Intended for electrophotography, the toner is biodegradable or hydrolyzable, which permits easy deinking and easy recycling of used copying paper.

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Key to Abbreviations

DE = German patent
EP = European patent
JP = Japanese patent
WO = World patent
US = United States patent
FI = Finnish patent
CA = Canadian patent
CN = Chinese patent
AT = Austrian patent
GB = British patent