

## **RECYCLING OF PAPER AND PLASTIC WASTES IN PLOVDIV REGION, BULGARIA**

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**Abstract.** The attention of all the developed countries to solid wastes has been redirected during the last years: the problem is not only to treat them, but in the process of industrial production to obtain smaller quantities of them. Nowadays the basic approach in the world practice is to make wastes harmless by depositing and controlling them, as well as to develop industrial methods of their processing. These methods include burning, composting, recycling, etc. Recycling is an advanced method of reducing the quantities of solid wastes, thus protecting the environment. Waste paper and plastic materials comprise a big part of the total amount of solid wastes. Technological schemes are discussed for producing cardboard, corrugated cardboard and wrapping paper from waste paper as well as plastic packing containers from waste materials. The products obtained are of lower costs, good technological properties and they are widely used in household.

*Keywords:* paper, plastic wastes, recycling, environmental protection.

### **AIMS AND BACKGROUND**

Each household deposits large quantities of unnecessary items, such as old newspapers, empty cans, bottles, scraps of food, worn out clothes, broken utensils and broken household appliances. Usually all this is thrown away, thus violating one of the basic ecological laws – the cycle of substances in nature<sup>1</sup>.

The general term of all the things that we deposit from our homes and offices is solid household wastes, and its content is approximately the following: 41% paper, 21% scraps of food, 12% glass, 10 % metal wastes, 5 % plastics, 5 % wood and 3 % rubber and leather. Usually the wastes in Bulgaria are deposited at landfills. This results in pollution of the environment, polluting air and waters, too.

Secondary treatment of wastes, the recycling, is a good solution of the problem as developing branch with a prospective future. The main problems of the recycling of household wastes are the following:

- Separation – usually the various wastes are thrown in the same container; in order to recycle this material, it is necessary to sort it out at home or after collecting of all the wastes.

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- Lack of standards – it is difficult to carry out separation of the wastes because there are no standards (for various types of plastics or paper).
- Processing – there must be companies interested in treatment of the separated materials.
- Marketing – there must be industrial and customer market for buying products made of recycled materials.

## DISCUSSION

Recycling of waste paper is highly effective and profitable for every country. Trakia Papir Ltd. is an industrial enterprise for production of cardboard, wrapping paper and pasteboard from waste paper<sup>2,3</sup>.

The production of paper and cardboard is a technological complex including separate processes that are conducted by special machines after a respective technology. Each product has different characteristics that depend upon:

- selection of appropriate raw material and semi-manufactured articles for the production;
- change in the technological mode of some of the basic processes in paper production;
- introduction of additives in paper mass (fillings, colorants, flocculants, sticking substances);
- additional treatment of paper (corrugation, masking, reinforcing).

That enterprise also produces sanitary paper, which is very practical and hygienic as an item for usage only once (cotton wool).

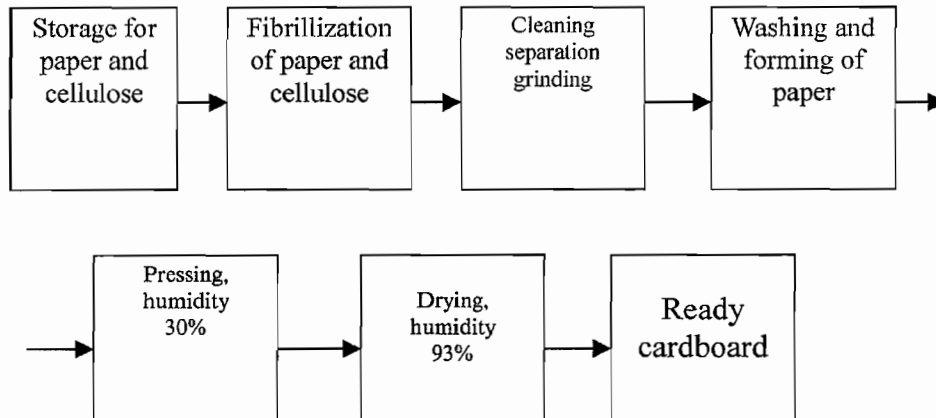
The basic raw materials used in the production processes:

1. Cellulose – this basic raw material for paper and cardboard production is used single or with adding of wood fibers and waste paper.
2. Wood fiber – this is a product from processing of coniferous and deciduous wood in the enterprises from the cellulose-processing industry.
3. Waste paper – it is an equivalent of cellulose and polycellulose in the production of various wrapping paper, cardboard and corrugated cardboard.

Additional raw materials in used the production process:

1. Colophony glue – it is used for sticking of paper mass in its liquid condition. Colophon is obtained from natural pine resin.
2. Aluminum sulphate – for sedimentation and fixing of the particles of the colophony glue upon the surface of the cellulose fibers.
3. Resins – urea-formaldehyde resin is used for paper reinforcement; as well as other synthetic resins are used as fixers.

The block-scheme for production of cardboard is as follows:



Thus obtained cardboard is produced in two varieties:

- common cardboard - which is rough and could be of one-layer cardboard, two-layer cardboard, or multi-layer cardboard;
- corrugated cardboard - which according to the number of the smooth and corrugated layers could be: two-layer cardboard (one smooth and one corrugated layer), three-layer cardboard (two smooth layers and one corrugated layers), and multi-layer cardboard. The corrugated cardboard is offered to the customers under the name of "velpape".

The basic stages of the processing of waste paper are separation, refining, obtaining of technical cellulose and drying.

Refining has three phases: mechanical fiber-formation, which could be rough by hydro-pulpers, or fine in vortical rotary or vibration purifiers; thermal treatment, and chemical treatment.

From all the polymers synthesised by the modern chemical industry the plastics are most widely used. The items of thermoplastics, reactoplastics and synthetic resins are widely used in the household, agriculture and industry. Their production and usage leads to a steady tendency of accumulation of solid wastes in large quantities. Their environmental degradation is extremely difficult, they do not putrefy, and due to their low density they float on the surface of water-basins. In landfills the contact of PVC packages with water, dissolutions or other wastes could result in toxic leak of plastificators in ground waters and soil. Burning of PVC together with other wastes in incinerators results in emission of toxic substances (dioxins for example).

This ecological problem can be solved by secondary processing of plastic wastes. The items obtained after the recycling are cheaper and could be used in the every-day life.

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The enterprise "Chimik-Assenovgrad" is situated at 20 km from the town of Plovdiv. It processes plastic wastes to end products, such as bags, secondary folio and plastic covers, pipes, etc.

The process of recycling is the following: preliminary separation of wastes according to their colour and type, cutting, washing, drying, granulating and technological processing into a ready product. The basic problem of this enterprise is the supply of the secondary materials for production (they import them). The separate collection of plastic wastes is not regulated by any law. This is the biggest problem for all such enterprises in Bulgaria, which must be solved.

### CONCLUSIONS

1. The effective management of the socio-economic and scientific-and-technical processes and their harmonisation with the activities for protecting the environment requires first of all good information for the society and its state organisations.

2. For the effective usage of the solid wastes (paper, plastics, etc.) it is necessary to establish a rational system for separation of collection of the solid wastes from households.

3. The separate collection of the wastes for secondary processing could be signed to private firms and companies or organisations of the municipality.

4. The persons engaged in solving of this problem must be financially encouraged.

### REFERENCES

1. B. NEBEL: Environmental Science. Moscow, 1993 (in Russian).
2. Programme for Management of the Activities for Collecting and Usage of Wastes. Municipality of Plovdiv. Republic of Bulgaria, 1998 (in Bulgarian).
3. Guidelines for Wastes Recycling. "STENO" Publ. House, Varna, 1999 (in Bulgarian).

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