



## Rubber recycling

*Rehan Ahmed and Arnold van de Klundert*

GATHERING WASTE MATERIALS for recycling is least of all a new phenomenon as it done by tens of thousands of people in urban areas all over the world. Waste provides the poor people a last resort to get employment through continuous struggle to survive with minimal income, bad working conditions and socially inferior status.

Enhancing the reuse of solid waste can restore some natural cycle and can contribute to solutions of urban issues like food production, waste disposal, energy shortages and improvement of environmental quality. Recycling decreases the quantity of waste to be collected and disposed, provide job opportunities to the poor people, conserve finite resources and save environment. The items commonly recycled are paper, glass, plastics, rubber etc. Recycling of rubber receives less priority and attention than other waste materials like paper and metals due to its financial value, margin of profit, final product, marketability, quality and public acceptance. This paper examines local technologies and legislative measures practised in industrialized and less industrialized countries and suggests actions for an optimal reuse of waste rubber.

### Waste rubber production

Population growth, rapid industrialization and increase in living standards have also caused extensive usage of rubber producing proportional quantities of wastes. Vehicular tires constitute the most important single item in terms of volume. In the industrialized countries rubber tires alone account for 60 percent of the total rubber consumption. With the increase in automobile and bicycle production huge quantities of waste rubber tires are turning into waste mountains. In a modern car it is possible to find besides the tires more than 500 different rubber parts, whose total weight varies from 30 - 45 kilogrammes. In USA about 242 million tires are discarded annually. In Canada the figure is 10 million, while Germany wears out 0.6 million tires, France 0.4 million, U.K. 0.74 million and Italy 0.37 million a year. According to estimates one scrap tyre per person per year is produced. In highly industrialized countries used tires constitute around 1 - 2% of total municipal solid waste.

The remaining 40% of the rubber waste mainly consist of tubes, conveyer belts, left overs from the shoe making industry. Other waste rubber produced consists of rubber parts, washers, insulation material in electrical appliances, packaging etc. and constitute a smaller proportion.

### Reuse, recycling & resource recovery technologies

In the industrialized countries tubes are mended only few times when punctured. Fairly good conditioned rubber tires are discarded within their life span due to over cautiousness, affordability, insurance, expensive manpower and high speed limit on highways. Damaged tires are seldomly repaired and re-used due to safety measures. Retreading and regrooving is not a common practice adopted, but is slowly gaining popularity due to stringent environmental laws, cost of tires and improved retreading technology.

According to fair estimates 40-50 percent of the abandoned car tires and 60-80 percent of the truck tires in industrialized countries are suitable for retreading and reuse. The recycling and reuse rate is fast declining due to failure of new technologies to penetrate the market as well as collapse of the reclaiming sector industries. Major quantities of rubber tires are stock piled and dumped on land. In the U.S.A. for example only seven percent of the waste tires are recycled, while eleven percent are incinerated for their energy value.

The exhaustion of traditional disposal sites and strict environmental controls are contributing to a rapid increase in the cost of waste disposal services. In Germany and the Netherlands \$ 75, in England and Denmark \$ 46 and \$ 26 per 1000 kg. Consequently, policy has shifted from a simple throwing away attitude towards prevention of waste generation and recovery of waste. Waste tires are made into crumbs and used for fuel. The rubber tires (32.5 MJ/kg) produce almost as much energy as liquid fuels (42 MJ/kg). This practice of obtaining tyre derived fuel (TDF) is also fastly declining due to availability of alternative fuels, environmental pollution and strict environmental regulations. Technologies are however available to keep the emissions within limits of the environmental legislation.

In industrialized countries creative and technologically sophisticated projects have been launched which utilizes huge quantities of rubber. The market for moulded rubber products is however growing due to higher process for virgin rubber and the public acceptance of products containing recycled rubber material.

The use of waste tires includes using it in artificial marine reefs, sport tracts, manufacturing of wheels for moving appliances and furniture, rubber flooring, protecting coasts from erosion, use in highway surfaces as additive to as-

phalt, drainage for sanitary landfill sites, insulation of foundations.

In the less industrialized countries waste rubber and discarded tires form a lower percentage of the total waste generated. Waste tires are reused and recycled to the greatest possible extent: from large organized industries to unorganized and informal micro-enterprises. In these countries tires are less regarded as a waste problem. Local people find indigenous uses for them replacing other expensive and non available materials. Waste tires and tubes are segregated at household and communal level and collected by waste pickers who transport and sell them to dealers and small enterprises. Tubes when punctured are repaired by hot or cold method and used again more than its normal life. The tires are also repaired when cut. When the tyre loses its threads, retreading and regrooving is accomplished based on the available thickness of the tyre.

In these countries the recycling differs somewhat technologically due to type of tool, machinery, equipment the workshop owner can afford. Besides the craftsmanship is an important element. This causes a difference in quality and quantity of the recycled products and thus the market such products may be able to cover.

Waste rubber tires have different uses but only few have any big commercial potential. However hundreds of workshops or individual craftsmen process discarded tires into a variety of products. Basically there are three ways to recycle waste tires: direct product re-use, material re-use and energy recovery.

The first choice is repair and reuse of the product. All material of the product is saved. The least energy is wasted.

Examples of this category, whereby neither the original state is not changed nor any mechanical process is applied includes uses like making plant pots and holders, fenders for ships, harbour walls, crash barriers, fencing, the use of whole tires as walls for water wells, buffer blocks for traffic signs, oil spill containment booms, buffer for ship roads, covering material in agriculture and for children sports.

In the second category the product is processed to use its material. It includes uses like the making of footwear, containers, animal and hand carts, buckets, washbasins, doormats, ropes, harnesses and straps, flooring, parts for bicycles, furniture, pads, bushes, washers, gaskets, insulators, patching in tires, pipeline protection and other indigenous uses like rubber slates, mats, packaging etc.

The use of the rubber waste for energy use, is applied in the cement industries or in kilns for firing pottery or earthenware as well to produce steam, electricity, steel etc. Discarded tires are also burned for another purpose: to recover the steel wires in the tread of the tyre for packaging for example waste paper into bales.

## Government policies and legislative measures

At present the government policies in the less industrialized countries are not much favourable for the recycling

and reuse technologies. Some of these countries have regulations and legislation (to some extent) yet no incentives are provided by the Government and municipal agencies to the informal recyclers. Practically government policies in the less industrialized countries are not geared in adopting the optimum recycling and reuse strategies. This is mostly due to the unawareness and giving low priority to the conservation of resources and utilization of waste. On the other hand there is bias towards high-tech modern solutions when equipment is bought. The funds spent on this by local governments and donors do however restrict the application of the equipment to well to do and central city areas. Moreover waste pickers are often hindered in the execution of their useful task in the removal of discarded waste.

If there is 'environmental' legislation, there is often a severe problem in the enforcement: there is either lack of budgets and trained personnel or companies dodge the regulations or bribe the executing officers.

In the industrialized countries the growing environmental awareness and the correspondingly growing legislation and the bureaucracy for the enforcement causes more and more waste materials to be recycled. Companies consider it part of their marketing strategy to show a 'green (environmentally sound) image' In the European Union (E.U.) the problem of the waste tires has the attention. Agreements are made between industries and government on an approach of this problem. The first priority is on the decrease of the quantity of discarded tires through e.g. the reduction of the maximum speed on highways, a change in driving style and the extension of the life span of the tires.

The E.U. also suggests an increase in the distribution and sale of retreaded tires in the private sector so as to reach a level of 25% of the replacement market within a couple of years. Major retreading in Europe is done in Italy and Denmark. The retreading of passenger tires however has a bad image among car drivers and the difference in price between a new and a retreaded tyre is not big so far. Promotion of retreaded tires is therefore necessary.

Only 2-3% of the discarded tires in the E.U. are ground to become granules. It appears that granulation could be boosted. The application of these granules is however limited since the granules can not be vulcanized again. Modern chemical technologies are however being developed to make these granules suitable for a wider application.

Figures on the recycling and reuse of waste tires adopted in less-industrialized countries show that for example in Mexico City and in Cairo, Egypt, 25% and 22% of the used tires respectively are being recycled. The recycling and reuse is mostly adopted by low income people to obtain a decent livelihood in a competitive market where human resources are abundant. Hundreds of people have gained useful employment in this sector now. Indirectly they are contributing towards waste minimization and resources conservation. Besides they provide a large number of low-income people with products they can afford. A market which is open for the importation of discarded tires or

governmental legislation restricting the collection of used tires, or the establishment of 'informal' workshops will seriously destroy such advantages.

To save the costs and foreign exchange, the government should levy import duties and regulations on virgin materials for promotion of recycling enterprises. The amount obtained can be spent on research and publicity of recycling. It is being noticed that with the import relaxation and minimizing the duty, the collection and utilizing of waste rubber has drastically reduced like in Malaysia and Sri Lanka. Besides return of used items like rubber tires needs to be promoted by the producers/agents through refunding a small amount which will enhance better collection and utilization of waste tires.

### Incentives

Recycling and reuse of waste rubber in less industrialized countries should be promoted. Incentives are to be provided to the waste recyclers and the people involved in waste collection and disposal. Regarding use of waste rubber utilization, the following incentives are recommended:

- official recognition of informal waste material trade by giving permits for waste collection, recycle and reuse to people and to allow less sophisticated (but safe) means of transportation into town;
- formation of small scale recycling unions and associations to be able to negotiate united with licensing departments and to exchange experiences.
- allocation of land on easy instalments at reduced cost to the recycling enterprises and at spots which can be reached easily by waste pickers and dealers/middle men transporting the waste materials;
- providing opportunities for on the job training and initiating short courses in easy local languages for low income people to be involved in recycling trade;
- involvement of NGOs, voluntary and civic organizations in recycling and reuse projects;
- disseminating information and education regarding providing health facilities and protective gears to the people in the recycling business, like masks, gloves and shoes.
- research and development of innovative, feasible technologies for the reprocessing of waste materials through small and micro-enterprises.

### Waste rubber utilization strategy

Based on the detailed studies conducted by seven local consultants (5) the following strategy and sequence is recommended for optimal recycling of waste rubber tires:

- waste reduction at source.
- repair and reuse (regrooving, retreading, casing)
- reuse as whole tires (artificial reefs, erosion control, crash barriers, fenders, thrust blocks, oil booms etc.)
- reuse after mechanical process into items of daily use (container, footwear, mats, flooring, parts of bicycle, etc.)

- recovering the raw material for making new products (natural or synthetic rubber, carbon blocks, fabric and steel wire).
- obtaining Tyre Derived Fuel.
- shredding at land filling in mono fills.

### Recommendations

On the basis of a literature study made on items and technologies adopted in less-industrialized and industrialized countries the following general conclusions are made:

1. In industrialized countries advanced technologies are adopted and usually supported by the government due to environmental considerations. A north-south cooperation is suggested like homogenizing the inputs and outputs in European Union and America. Economically viable and commercially feasible alternatives are to be adopted based on environmental legislation.
2. Based on the available tool, equipment, machinery and manpower, the low cost technologies are practised in the developing countries. There is a strong potential of utilizing the available local skills within a country and sharing knowledge within the developing countries.
3. The use of products produced from waste rubber are to be promoted. The entrepreneurs should be recognised and incentives to be given for increasing the quality and quantity. Appropriate legislation is to be framed, imposed and enforced favouring recycling, reuse and resource recovery.
4. Environmental effects are to be assessed and monitored for the recycling processes, products and working conditions.
5. Technical advisory services are to be provided by NGOs or institutions to the small scale recycling enterprises for improvement of recycling technologies.
6. Public education and awareness programmes are required for separating clean recyclable items and sending it to the recyclers. The products are also to be patronized and favoured.
7. The prime consideration of used rubber tires are reduction at source, but not comprising with the safety of vehicles. Tyre life can be increased by modification of the tyre construction, i.e. changing to radial technology and use of better weaving material.

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