ICCPGE 2016, 1, 25 - 30

Using the Latest Techniques in the Processing and Recycling of Used Tires in Libya

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Abstract

To address the problem of polymers used featured numerous innovations in a number of developed countries, and included in numerous studies to cope with this phenomenon, and these methods and the most suitable are recycling, recycling polymers are industrial operations environmentally friendly and produce useful products from harmful waste, the product and the method of manufacturing incompatible with the principles of cleaner production and friendly program, polymers prepared (synthetic polymers) This includes the type of polymer plastic materials and synthetic rubber (tires) and leather, industrial fabrics and nylon and polyester and dyes and paints, glass and metal and other organic, this paper analyses the amount of waste tires produced in Libya and then discarded. The importance of doing this research is to find out ways to recycle the waste tires into products to reduce the amount of waste tires in Libya, recycling provides a sustainable source of materials by processing a priority waste so that it can enter into a new cycle of life-extending the functional value of the original resource while reducing the energy required in production, the research methodology entailed compilation of secondary data as well as field work so as to collect primary data, Establish the magnitude of dumped tires, explore creative use of scrap tires to provide raw materials usable in design of new products, mount an exhibition of ideal designs using used tires as raw materials, using the best techniques in the world of tire recycling.

Keywords: Tires; recycle; polymers; technique.

1. Introduction

Wastes generally are inevitable products that are generated by every living organism. The volume of waste generated by various organisms is related to their size or complexity. Before the industrial era, anthropogenic wastes include but not limited to those from physiological processes, ashes from burning wood, agricultural and animal wastes which are buried in the ground. However, with increase in population, the volume of waste generated also increases.

The industrial era brought tremendous improvement in the standard of living of man. This was also accompanied by the introduction of different kinds of waste materials some of which are detrimental to our lives and the environment. These wastes are in form of solid wastes,waste tires, broken glass, spent nuclear fuels, plastics; liquid wastes leachates, general chemical and gaseous waste such as methane emitted from landfills, carbon monoxide etc. Waste tires has been classified tires that are bald and worn down to the tread belt or have bulges or sidewall damage and are not suitable to be retreaded as a result of long usage. successfully noted in her phrase "The human race is challenged more than ever before to demonstrate our mastery - not over nature but of ourselves", we are challenged to find ways to produce more energy, reduce our waste production while minimizing use of limited natural resources.

Recycling of scrap tires in the US can be taken as an example; about half of the manufactured automobile tires used to be recycled since only synthetic or natural rubber was used in the tire manufacturing process and tires could have been directly used

without major processing. Recycling of used tires was further encouraged by the fact that these materials were also expensive. The increasing use of the synthetic rubber, however, lowered the manufacturing costs and reduced need for recycling. Moreover, the development of steel belted tires was almost the end of tire recycling since additional processing of tires was needed. Consequently, The average motor vehicle will go through several sets of tires in its lifetime. As the number of vehicles on our roads continues to rise, the problem of scrap tire disposal presents serious waste management challenges for society. Used tires become waste when worn tires are replaced and when vehicles reach the end of their life. The industry has been created virtually due to government regulations enacted to address the environmental concerns about illegally dumped or stockpiled tires. Governments are also trying to improve the viability of the industry by providing incentives to end-markets that use scrap tire derived products. The scrap tire recycling industry is at different stages of development in different countries.

2. Recycling Techniques

2.1. Whole tires in engineering and industrial applications

Techniques have been developed to create wall building blocks. This is achieved by removing the sidewall of the tire, creating a structural unit which can be filled with crushed rock, gravel or sand to create a block. This is apparently cost-competitive with conventional methods, and as a low-technology solution could be suitable for non-urban areas. Tires can also be baled, and used in construction, seawalls and jetties, and so on. Portable balers are available [1].

2.2. Granulated rubber which includes buffing

This is generated from old tires. The tires are destroyed by various different technologies, which result in granulate or rubber powder. This powder varies in many ways, such as composition, size, surface area and level of impurities.
Composition of the powder would, in an ideal world, be based around the different components of a tire so that granulate produced exclusively from truck tire tread compounds is made from mixtures of natural rubber, carbon black and various chemicals and accelerators. On the other hand, granulate produced exclusively from inner liner material would end up being composed of halo butyl rubber, also mixed with carbon black and some active chemicals [1, 9].
This level of discrimination is not possible at the current state of the art, so in practice, the industry has three broad types of granulate:

- The basic and most common grade is granulate made from mixed whole tires.
- Next comes granulate made from exclusively car tires.
- Next in the scale is granulate made exclusively from truck tires and;
- Finally there is granulate made from tread buffing.

The materials made from buffing are composed almost exclusively of natural rubber, carbon black and active ingredients. Material sourced from whole truck tires has around 20 percent synthetic rubber content, including butyl from the inner liner, and SBR and BR from the carcass and sidewalls. Nevertheless, the polymer in this material is typically around 80 percent natural rubber. Granulate derived from car tires is usually around 60-40 synthetic and natural rubber. It also contains silica and other materials and is less repeatable in terms of content. Crumb made from mixed tires may have content ranging from 60 percent synthetic down to less than 10 percent and is even less likely to be repeatable from batch to batch.
The surface texture of each granule depends on the production process. Cryogenic grinding takes less energy to break the rubber apart, as the rubber fractures, leaving smooth, glass-like surfaces whereas ambient grinding rips the rubber apart, leaving rough textures with a high surface area-to volume ratio. The following are notable applications for ground rubber: road surfacing, rubberized bitumen and asphalt, incorporation into rubber and plastic products, molded and extruded rubber products, synthetic turf, protecting coatings, industrial flooring, building materials, traffic guide posts, soil conditioner, production of new tires [2].

2.3. Pyrolysis

Tire pyrolysis is a process of converting waste plastic and tires into Pyrolysis oil, Carbon black and

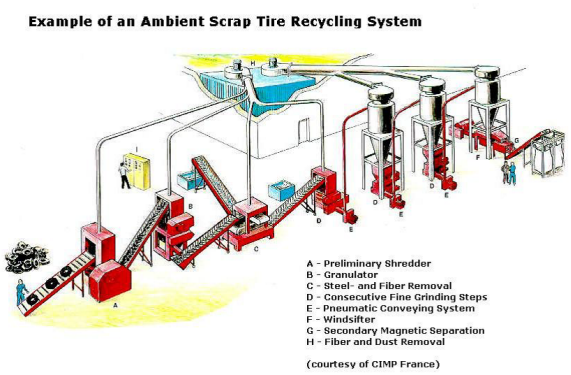

Figure 2.1: Technique scrap tire recycle.

Figure 2.2: Rubber granules resulting from the recycling process [3].

hydrocarbon gas. Pyrolysis is process of molecular breakdown where larger molecules are broken down into smaller molecules. Pyrolysis plant is an industry designed to carry out pyrolysis of waste plastic & tire. In case of plastic/tire pyrolysis, long chain polymer is broken down into smaller chains of Hydrocarbon Gas and Pyrolysis Oil. Heat and catalyst are required for the reaction.
The scrap tires will decompose when it heated up to a 160 ^{o}C in the reactor. The decomposed tires transformed into oil gas. Waste gas will be processed in the emissions scrubber transmitted by the pipe on the top of the cracking reactor, by the processing of emissions scrubber the harmful gas will changed into clean air then release into the air.
When crude oil get through the gas separate the Impurities will be filtrated, so that crude oil can be refined. Crude oil get through the depositing tank to the cooling pool for cooling in it, then transform into liquid. Liquid crude oil will delivered to tanks for store, and the exhaust gas from the crude oil in the tank will transported to exhaust gas recycle system then transported to The bottom of the cracking reactor as fuel to heat up the the cracking reactor .
In pyrolysis as a process, the polymer waste is not burned; instead it is broken down into usable finished products like Pyrolysis Oil, Hydrocarbon Gas and Charcoal. In case of plastic/tire waste management, pyrolysis is better alternative compared to incineration or dumping. Incineration is burning of waste which leads to loss of valuable energy from polymer waste. Dumping of polymer waste is known to cause land pollution. By pyrolysis of polymer waste, it is possible value from waste in the form of Pyrolysis oil, Hydrocarbon gas and charcoal.

2.4. Devulcanization

In chemical terms, devulcanization means reverting rubber from its thermo set, elastic state back into a plastic, moldable state. This is accomplished by severing the sulfur bonds in the molecular structure. With the proper devulcanization method, a much higher percentage of crumb rubber old tires can be used as compounding.
Traditional devulcanization methods involved exposing cured rubber to elevated temperatures for an extended period of time. However, this "thermal reclaim process" not only severs the sulfur bonds in the polymer matrix, but also breaks the polymer chains, causing a significant decrease in physical properties. Because of questionable economics and environmental concerns, thermal devulcanization is rarely used today.
The current price increase of virtually all types of polymers, including natural rubber, means that for most rubber manufacturers, reprocessing rubber scrap is no longer an interesting alternative, but an economic necessity [4].

2.5. Use of scrap tires as a whole or after mechanical processing

Scrap tires can be utilized by making use of their sturdy nature and steel reinforcement inside the rubber. The steel wires are usually protected inside the rubber if the rubber is not severely cracked or eroded. Therefore, the tires can survive for long periods of time even under harsh environments such as a boat bumper in salty sea water, under a paved road.

2.6. Whole tires in making products

Tires can be used in making products like. The tire swing lives on as a simple recycling project for a tire. You can hang the tire vertically or horizontally, just make sure to pick a thick branch that can support the weight of someone swinging wildly on a tire. For the vertical tire swing, attach the rope from the tree branch to the top of the tire. Also Tire sandals never go out of style as a way to recycle tires. Draw an outline of each foot on a piece of paper, then draw another outline outside that one, making it about one-half inch bigger around the sides and toes of your foot. Furniture can also be made from tires, planters and many other products.

3. Research Methodology

3.1. Research design

The design of my research followed the following procedures that enabled the researcher produce project paper. A target population was identified first from which information was got from through. This research focuses on qualitative and quantitative research procedures. It involves close observations of car, recycled products and initiatives from the point of view of materials and techniques.

3.2. Population

The dependence data obtained from the statistical handbook 2010.

3.3. Sample

It was taken Misrata city as a sample of this research, which represent approximately 10% of Libya's population.

4. Analysis and Discussion

4.1. Case study (Misrata city)

This was done to account for the data collected. Patterns were explored and emergent ideas on tire waste recycling and the cycles documented. This includes comparison of data collected.
Tires used for the number in 2007, and should be noted that 91% of it owned by small cars from Table 3.1, the sales of tires it is represented sales achieved safety tire company and AMAN from Table 3.2, determine the volume of consumption of the tire through the per capita consumption It has been relying on statistical results to the census in Libya for the year (2010), which was prepared by the National Commission for Information and Documentation and in determining the rate of consumption of the individual frames. Table 3.3 the results of the population census shows during those years.
Through the above tables can identify the following points:

- The estimated population of Libya in 2010 and using the annual rate of growth (1.8%), the lowest rate of population growth in the city of Misrata, about (554 074) people [4] .
- Some reports indicate that the per person in year consumption of tires in the industrialized countries of (3.1) tire every citizen, and if we consider that the rate of consumption in Libya in the range of (1) tire each (2) persons, The number of damaged tires that can be obtained is the (1939) tons in 2010, and within the limits (2120) tons in 2015, The Misrata area share amounts for the years 2010, 2015, respectively (277,037) framework, (302 882) framework, so as the contribution ratio (9.71%) of the total population.

4.2. Damaged tires available in Libya size

It has been relying on statistical results of the census of population in Libya for the year 2010 prepared by the National Commission for Information and Documentation, in determining a person's consumption of tires per year, Reports indicate that the person consumption rate in the industrialized countries of a single part of a year.
If we consider that person's consumption rate is half as part of a year, the number of damaged tires in the year 2010 will be 1939 tons and 2120 tons in 2015.
Where the city of Misrata are the subject of a study contributes with 9.71% of the total population in Libya.
Been identified tire size available through the annual import and sales of locally manufactured tires, as well as using the per capita consumption rate as follows:
1.2.3 Virtual annual requirement of tires:
Was considered that the annual requirement of the virtual tires = annual volume of imports, in addition to the sales volume of the investigator domestic production - exports [4].
By studying the data presented in Table 3.1 on imports of tires and other rubber products note the following:

Table 3.1: Imports of tires and rubber products most different in Libya [2].

No.	Statement	Unit	Imports			
			2003		2007	
			Values	Quantity	Values	Quantity
1	Rubber tires for small cars	Number	7738194	432662	24665239	1615500
2	Great cars and trucks and bus tires	Number	8533200	150131	20619586	149648
3	Aircraft tires	Number	432649	452	476391	907
4	Motorcycles normal tires	Number	19526	2710	45244	4744
5	Various other tires	Number	2037206	899984		3799494
6	Twine and ropes and rubber tubes	kg	12294141	5117115	12853618	9541283
7	Inner tubes	Number	259489	79012	518360	225358
8	Used tires **	kg	366013	120960		1298788

Table 3.2: AMAN company tire data [2].

Product type	The design capacity	Detective in production		Total sales year	
		2008	2009	2008	2009
Small tires	323310	7510	6	4767	2228
Light transport tires	61787	6377	1779		
Heavy transport tires	86222	1729	916		
Tractors tires	21588	226	20		

1. Notes that there is a significant increase in imports in the small car tires, where an increasing number of tires in 2007 compared to 2003 growth rate of 273% and a compound growth rate for the period (2003-2007) is about (39%).

2. Intended item used tires is the tire supplier from abroad Used but good and usable technical condition, which is sold for a relatively cheap compared to the price of modern tires.

3. There is a clear line in the source, a different item frames and other terms are often drawn carts and wagons, carriages ringed extensions Tractors and hand vehicles tires, an item cannot be neglected for the large number of these tires during the years 2003.2007.

4. Yarns and cords and rubber tubes are also important items in order to lightweight and easily manufactured, and the extraction where the rate is very high and the amount of large annual consumption of them, however, arises upon an important point is the difficulty assembled in spots and clear and in large quantities, which may lead to a rise the cost of the assembly and supply of the plant.

5. Conclusion

- Conclude that the production capacity necessary for the plant, recycling is 50 tons per hour.
- The use of the latest technologies in the field of processing and recycling of used tires.
- Design all stages of production and manufacturing processes of modern programs in the field of manufacturing.
- Get on the raw materials for new products.
- Feasibility of the project technically and economically feasible to recover and be capital in a short period of time.
- Support research and future studies on recycling and manufacture of tires and products.
- Spread environmental awareness and reduce the output of the summation used tires pollution.

Table 3.3: The number of residents of the city of Misrata and the number of damaged tires [2].

weight tier/ton	The number of damaged tires	Growth rate	The population of the city of Misrata	Years
1939	277037	1.8	554074	2010
1974	282023	1.8	564047	2011
2009	287099	1.8	574199	2012
2045	292267	1.8	584534	2013
2082	297527	1.8	595055	2014
2120	302882	1.8	605765	2015
2158	308334	1.8	616668	2016
2197	313884	1.8	627768	2017
2236	319533	1.8	639067	2018
2276	325285	1.8	650570	2019
2317	331140	1.8	662280	2020

- The establishment of a database for tire recycling in Libya base.
- Highlight the role of recycling in the hoisting of the national income level.
- Used Modern technologies and environmental solutions for the recycling of tiers.

6. Recommendations

- Study the possibility of establishing several industries using rubber granules resulting from a recycling.
- Use of environmental management to reduce the damaged tire.

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