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ROLE OF RECYCLING OF USED AUTOMOTIVE COMPONENTS AND ITS EFFECT ON REDUCTION IN CARBON FOOTPRINT AND SUBSEQUENT ENERGY CONSERVATION

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Abstract

Global warming is one of the major issues nowadays due to carbon emissions. In most conversations about ecological matters and guidelines, the conveyance is emphasized as one of the leading contaminant emanations and energy utilization resources. The consideration presented to motorized manufacturing is comprehensible in this perspective due to its size, high rate of growth, existence in our day-to-day life expectancy, and of course, its environmentally friendly influence. Suppose we examine the "greenness" of car producers. In that case, we will discover concern in unprocessed substance use, manufacture procedures, road use, and activities on End-of-Life vehicles. The most critical manufacturing problems are high energy intake, high carbon footprint, excessive use of raw materials, and wastewater disposal into natural water resources. This leads to contamination due to ingredients of worry, like Cadmium, Lead, Hexavalent Chromium, and Mercury. Because of the carbon emanations and power use, cars' service is the leading stage of its life cycle due to the mixture of internal combustion engines with fossil fuels. The latest pressure is aimed at the End-of-Life vehicles (ELV). Landfills locations are also becoming deficient, and the pollution of soil and aquifers fulfils the picture. In this paper, the researchers have focused on reusing used automotive components and their benefits on energy conservation, reducing carbon footprint, and minimizing the landfill requirements for dumping the scrap gathered from automotive parts after its expiry.

Keywords: Reuse, Recycling, Pollution, Carbon footprint

1. INTRODUCTION

At an overwhelming pace, our world is shifting. Globalization, emerging technology, and the Internet are the driving forces behind this transition. As the Industrial Revolution did 200 years ago, digitization revolutionized our lives in the same progressive manner. Computers, mobile phones, and robotics redefine how our free time is exchanged, shopped, and invested, and what our everyday life at the workplace and in the factory looks like. Of course, digitization is also changing our way of shaping our mobility. But the environment, on the other hand, is being contaminated by transport. An individual and community must minimize the carbon footprint to save our planet from controlling global warming[1]. In the mainstream media and professional conferences, environmentally sound innovations are frequently discussed today, especially those associated with land use, agricultural guidelines, pesticides, inherently modified bacteria, trash reduction, reprocessing, renewable energy, crossbreed vehicles, etc. Not surprisingly, at many conferences of the International Association for Technology Management (IAMOT), presenters concentrated on eco-development and sustainable growth. With global recognition of weather change challenges and the reduction of fossil feeds, it is predicted that these topics will remain the center of concern shortly. Conveyance is one of the key causes of noxious waste pollution and power use in most debates on environmental issues and policies. Due to its scale, growth, involvement in our everyday life cycles, and, course of action, its ecological influence, the consideration is given to the automotive business is comprehensible in this perspective. When we investigate the "greenness" of carmakers, we will find questions regarding the usage of raw materials, manufacturing practices, use, and end-of-life vehicles. Soaring spending of electricity, unprocessed ingredients, water, and trash streams, including the four components of anxiety, are the main production concerns (Cadmium, Lead, Hexavalent Chromium, and Mercury). Owing to the integration of internal combustion engines with fossil feeds, vehicles' use is the primary step of the life cycle in terms of carbon emissions and energy use. The most recent pressure on end-of-life vehicles is directed at (ELV). Traffic delays and traffic crashes appear to be part of the downside of automotive culture, in addition to the emissions from vehicle use. Landfill locations turn out to be insufficient, completing the picture with the impurity of land and aquifers. The end is impossible to foresee. The problem of moving towards recycled products and the necessity to reuse, reprocess and remanufacture inadequate raw material or costly used automobile parts will be faced by production knowledge for car manufacturing. This will also affect the final disposal of cars from End-of-Life [2].

2. SIGNIFICANCE OF ENERGY CONSERVATION

Reducing energy consumption during the development phase is one of the most appropriate ways to enhance manufacturing sustainability. Production procedures are energy-intensive, rendering this phase a leading resource of energy utilization and carbon imprint creation. Currently, the manufacturing industry accounts for nearly half of the overall energy spending in the world. There is still a need for energy-aware production to capture energy efficacy when making decisions during manufacturing operations. Productivity will enhance

because of less energy consumption during manufacturing and subsequent reduction of carbon footprint with energy conservation. Workers and employees of the industries should be given training or make them aware of saving energy on their own and its benefits for future generations[3].

3. CARBON FOOTPRINT

A company's carbon footprint is the amount of greenhouse gas (GHG) emissions emitted due to its operations. Carbon footprints are traditionally calculated in terms of an annual impression that ponders the organization's primary functions over a calendar year. However, it is becoming increasingly popular for manufacturing firms to communicate their per-product footprint. The carbon footprint unit is tons (metric tons) of carbon dioxide equivalent, whatever the measurement frame (CO_2e). The most common GHG produced by human activities is carbon dioxide. Still, the CO_2e unit often easily considers all other GHGs (such as methane and nitrous oxide) by putting them in CO_2 terms[4]. India's carbon footprint is rising at a faster pace than other nations, a recent study claimed. It is due to increasing fossil fuel consumption. The bulk of the energy consumed by India originates from fossil fuels[5]. Carbon footprint is a significant challenge because of automotive pollution from other challenges like poverty, cancer, terrorism, etc.[6]. Greenhouse gases (GHGs) are carbon dioxide CO_2, methane CH_4, Nitrous Oxide N_2O, and many fluorinated gases that increase the Earth's temperature due to infrared radiation absorption[7]. It is becoming increasingly popular for businesses to measure and communicate their carbon emissions as the climate crisis moves to the top of customer agendas[4]. Tata Motors Limited (TML) sustainability works extensively through its commercial and passenger vehicle segments on low carbon product growth[8]. Ecological Produce Model and Production play a crucial part in the environmental factor 6R (reuse, recover, recycling, redesign, reduction, and remanufacturing) (SPDM)[9]. The literature available on zero-carbon, renewable, viable, and ecologically approachable manufacture are vast, but its sophistication continues to form[10]. Each 10 % reduction in vehicle weight is found to reduce fuel consumption by about 7 %. Carbon footprint can therefore be regulated[11].

4. RELATION OF CARBON FOOTPRINT WITH ENERGY CONSERVATION

Energy conservation in the automotive sector by reusing used automotive components is responsible for reducing carbon footprints, which will undoubtedly positively affect global warming. The use of Alternative fuel instead of high-priced fossil fuel has increased 52 % tendency in the U.S. Due to lack of awareness of India's lousy environment's adverse effects, only 20 % of cars prefer to use alternate fuel[12].

5. RECYCLING OF USED AUTOMOTIVE COMPONENTS

The disassembling of automobiles for replacement parts is the recycling of cars. Vehicles have significance as a resource of spare parts at the end of their useful life, creating a market for vehicle dismantling. A car grinder is also used to minimize the scrapped vehicle's size for transport to a steel mill. Nearly 12-15 million cars hit the end of their use per year in the United States only. While out of service, these cars may yet have a role by offering back the metal and other biodegradable ingredients found therein. The vehicles are tattered, and the metal substance is retrieved for reprocessing. However, machines further process the remainder to recycle added elements such as tumblers and plastics in many areas. The rest is deposited in a landfill, known as automotive shredder residue. 75% of the items will currently be reprocessed, with the residual 25% end up in landfills. Recycling automotive components save energy considerably[13]. More than $32 billion in annual sales are funded by the U.S. automotive recycling industry and play a vital role in the effective, environmentally friendly reprocessing of end-of-life automobiles. Automotive recycling companies employ more than 140,000 people at more than 9,000 sites nationwide[14].

6. RELATION OF RECYCLING WITH CARBON FOOTPRINT

Recycling components of vehicles means that "once a user wants a specific component to refurbish his motor vehicle, the requirement will be met by procuring a second-hand part as an alternative in place of a brand new one." Thus, it is unnecessary to manufacture a new part, thus saving the energy consumed and CO_2 generated in that process. Besides, the reuse of products or auto parts leads to eliminating waste as a function of environmental preservation and environmental protection. In one of the case studies of the Japanese End of Life Vehicle (ELV) market, it was found that an average of 35.3 GJ energy and CO_2 were saved by reusing automotive components per vehicle. In the production of Aluminum Automotive components, primary power is required. Hence reusing components will decrease the carbon footprint[15]. One of the case studies found that 65,000 vehicles recycled, resulting in 2.2 million tons of CO_2 saved [16].

7. CARBON FOOTPRINT IN THE AUTOMOBILE MANUFACTURING INDUSTRIES

It is becoming increasingly popular for industrial companies to measure and communicate their carbon footprints[4]. Automobiles, providing recovery rates of up to 90%, are among the most recyclable engineered products. High-grade steel comprises roughly 65 percent of the weight of a standard saloon car. Another 7 to 8 % accounts for aluminum. Some other useful materials can be recovered, such as copper, noble metals in catalytic converters, etc., which can be recovered. It is possible to recycle plastic and rubber used in vehicles[17]. Not only is recycling well for the environment in general, but it is also suitable for consumers[18].

8. SCARCITY OF LANDFILLS AND ITS EFFECTS ON CLIMATE

Accumulated landfills cause tremendous pollution, in addition to taking up a lot of space. Because of more scrap, the shortage of land would be a big problem for society in the coming years. The collection of chemicals deposited into landfills and entering the atmosphere is the leachate product [19]—the release of toxic fumes into the atmosphere when waste material breaks down. Putrescible waste is evolved. It means solid waste containing

organic material capable of decomposing micro-organisms and producing odors[20]. Leachate was also able to drain into groundwater resources from landfills[21]. There are numerous rationales as to wherefore we should encourage reprocessing. Reprocessing allows us to turn our outdated manufactured goods into brand new and beneficial manufactured goods. It is suitable for the ecosystem, in other words. It helps to reduce air and water contamination by conserving reserves and dispatching less waste to landfills[22].

9. RESEARCH METHODOLOGY

A general survey concerning recycling used automotive components, and the overall carbon emissions/carbon footprint was carried out from manufacturers of automobile industries.

10. FRAMING OF HYPOTHESIS

If a company is recycling used automotive components instead of putting them to scrap (thereby leading to leachate issues), it should report lesser carbon emissions than those that do not.

H0: There is no relationship between recycling of used automotive components and mean carbon emissions.

H1: There is a relationship between recycling of used automotive components and mean carbon emissions.

An independent sample T-test has been carried out to analyze the results and concluded.

The output below from SPSS has been produced without reducing the font size to fit page width for better reading.

Table 1 – Group Statistics

Twenty-nine manufacturers recycle, and 42 do not (N = 29 and 42). The mean carbon emissions in tons are 6.72 and 6.38, respectively.

Table 1: Group Statistics

	Question: Do you recycle used products	N	Mean (tons)	Std. Deviation
Question: Carbon footprint for the same in tones	yes	29	6.72	1.192
	no	42	6.38	1.378

Group Statistics

	Question: Do you recycle used products	Std. Error Mean
Question: Carbon footprint for the same in tones	yes	.221
	no	.213

Table 2- Independent samples T-test

Significance for T-test for equality of means (italics) for equal variances assumed or otherwise is not significant. (P-values 0.280 and 0.268)

		Levene's Test for Equality of Variances		T-test for Equality of Means
		F	Sig.	t
Question: Carbon foot print for the same in tones	Equal variances assumed	.820	.368	1.088
	Equal variances not assumed			1.118

Independent Samples Test

		T-test for Equality of Means		
		df	*Sig. (2-tailed)*	Mean Difference
Question: Carbon foot print for the same in tones	Equal variances assumed	69	***.280***	.343
	Equal variances not assumed	65.461	***.268***	.343

Independent Samples Test

		T-test for Equality of Means	
		Std. Error Difference	95% Confidence Interval of the Difference Lower
Question: Carbon foot print for the same in tones	Equal variances assumed	.315	-.286
	Equal variances not assumed	.307	-.270

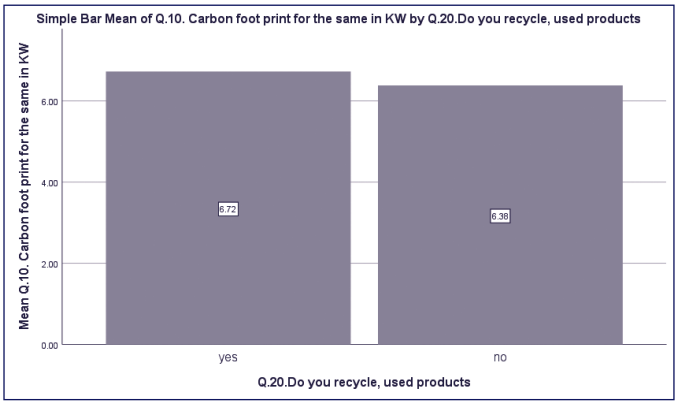
		T-test for Equality of Means 95% Confidence Interval of the Difference Upper
Question: Carbon foot print for the same in tones	Equal variances assumed	.972
	Equal variances not assumed	.956

/VARIABLES=Question: Energy requirement Annual energy requirement in KW, Question: Carbon footprint for the same in tones

/PRINT=TWOTAIL NOSIG

/MISSING=PAIRWISE.

Figure 1: Simple Bar Mean of question: Carbon footprint for the same in tones by question: Do you recycle used products/Components



11. INTERPRETATION OF THE ANALYSIS

As the test reports an insignificant relationship (If P values are less than 0.05, reject null and accept alternative), we welcome our H0 and conclude that there is no relationship between recycling of used products and carbon emissions. Explanation

– As the test results are against basic expectations, we can understand that the respondents' reporting of carbon emissions has not been adequately understood. Also, data on the release of CO_2, Methane, and Nitrous Oxide in landfills and the resultant increase in carbon emissions has not been correctly reported by the concerned person. Moreover, recycling is a secondary activity, and carbon footprint is for the overall business entity. It is possible that those companies which, even when they do not recycle, must be carrying out their other significant activities in a carbon-free manner.

12. CONCLUSION

These days every sincere citizen of India, especially and worldwide in general, is thinking about a clean environment to lead a healthy life. In this regard, transportation is considered a considerable obstacle. Day by day requirement of the vehicle is increasing. Recycling used automotive components has a crucial role in decreasing or at least controlling pollution by reducing carbon footprints and landfill requirements to control pollution. The literature on recycling shows a positive effect of recycling automotive components on the environment by reducing waste and carbon footprint. The survey data indicates that people of the Indian Automotive industries are still not much aware of the severity of the current and future climate change and health issues of the people due to carbon footprint. It is assumed that the industry personal may be saving energy in some other ways to control pollution and reduce carbon footprint.

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