

A Sustainable Future for Rubber Waste in Sri Lanka

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Abstract— Innovative construction materials have a high demand in the construction industry with the development of the green building concept and sustainable construction. The use of waste materials is encouraged even with the green rating system, and waste rubber is identified as one of the main waste materials generated in any country. Sri Lanka produces 4.5 billion solid waste materials per year. The management of waste material and implementing them in a productive way is essential for a country to promote sustainability. For rubber waste, solutions such as rubberized concrete have been introduced in developed countries. However, in Sri Lanka, rubberized concrete is not popular in the construction industry. Further, it is not clear whether the quality or the quantity of rubber waste available in Sri Lanka is sufficient to promote such application of rubber waste. Therefore, this study reviews the feasibility of using rubber waste available in Sri Lanka for a commercial application such as rubberized concrete. The wastage of rubber from different sources was identified as 1283.6 tons per month in Sri Lanka. Out of the whole batch of rubber wastage, latex rubber and tire rubber wastage were identified as the main types. The quality of rubber wastage is critical when using rubber waste in application. Literature on rubberized concrete suggests recycled crumb rubber and tire chips of 5mm to 20mm in size as suitable for rubberized concrete. Rubber crumbs of this recommended size can be found in Sri Lanka in sufficient amounts, which implies that there is a future for rubberized concrete in Sri Lanka.

Keywords— *waste rubber, rubberized concrete, sustainable, rubber types*

I. INTRODUCTION

Among the several issues arise as a result of population growth, waste generation can also be considered as a major problem. Several literatures have studied the effect of population growth on waste generation (Dallas et al. 1996; Lal et al. 2011; Das et al. 2014). From different solid wastes, rubber waste takes an important place as this waste

material grows with the rapid development of industries. The critical part on rubber waste is the non-biodegradable character, which cause hazardous impacts on environment (Yamamoto et al. 2001; Yehia 2004).

Sri Lanka experienced 4.5 billion solid waste per year (Gunaruwan et al. 2016) Therefore, it is essential to manage the solid waste properly and generate the solid waste to an asset like most of the developed countries. One such important waste material is rubber waste. Rubber waste is used as an energy source, construction material by reusing, recycling, hydrolysis, mechano-chemical reactions or reclamation (Yehi 2004; Senevirathne et al. 2020). Waste rubber has been identified as useful in many industries. One of the pioneer industry is the construction industry. In recent past decade various research studies were conducted to identify the properties of waste rubber as a construction material. As a result of that rubberized concrete was introduced and implemented on some applications such as, a replacement to lightweight concrete, on highway as a shock absorber, as a sound barrier, road barriers, shooting houses and firing ranges waste rubber used as a construction material. Moreover, implantation of waste rubber in structural elements also under discussion. With such variety of applications, the quality and the quantity of waste rubber is an essential topic to be concerned.

Therefore, the management of rubber waste is timely need area to discuss with the development in industries and population density in Sri Lanka. This study is to identify the rubber waste amount and its sources while conducting an analysis at the end.

II. METHODOLOGY

As the first step of the study, a survey was conducted to identify the sources of rubber waste and the collectors of the rubber waste. Two objectives of this survey are as follows;

- i. Identify the sources of waste rubber and nature of the waste from each source

- ii. Identify the annually generated quantity of waste rubber

Rubber is a multi function material which is used in many industries for several purposes. As a result of that wastage of rubber is high. Respective to this scenarios several local governing bodies and private institutes act as collecting sources of rubber waste. These sources can be mainly categorized as;

- Local government authorities
- Licensed private collecting institute
- Rubber manufacturing companies

Local government authorities and licensed private collecting institutes collect other solid waste materials too. Therefore, from the collected materials the percentage amount of rubber waste was identified. Importantly, several categories of waste collectors were identified. In addition to the role as merely collectors, some of these institutes collect rubber waste for the purpose of exporting (collectors and exporters), and some act as collectors and recyclers and also as only recyclers. Figure 1 represents the location of various waste collecting centers implemented island wide.

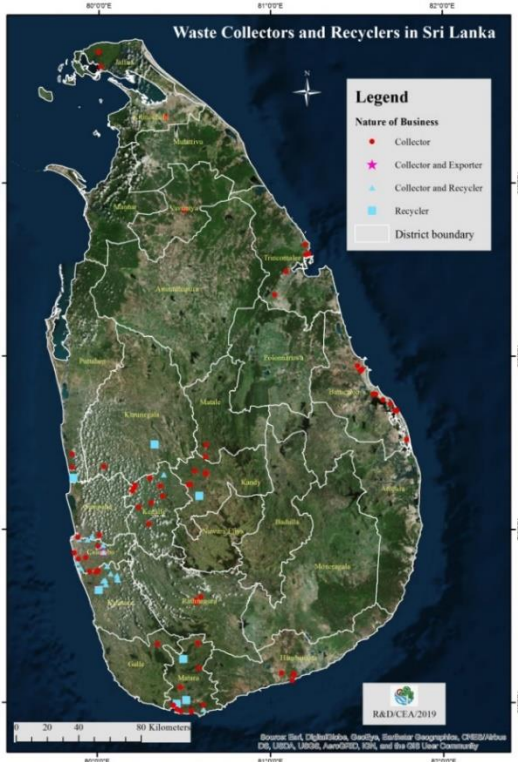


Figure 5. Waste collectors and recyclers in Sri Lanka (CEA 2021b)

Rubber waste from manufacturing process is one source of waste rubber. Therefore, manufacturers who involved in rubber related products, can be

identified as collectors of waste rubber who collect the rubber waste from their own manufacturing process. This study extended a survey to identify such manufactures as well.

Study was concluded by doing an analysis on rubber waste collected from each source and finding the percentages. Also, a percentage was obtained for the total rubber waste with respect to total solid waste material collected

III. RESULTS AND DISCUSSION

A. Survey on Local Government Authorities

Central Environmental Authority (CEA) of Sri Lanka is the main governing body on all kinds of waste materials. CEA has organized group of local responsible bodies on waste material. The collecting and managing those waste materials are main two responsibilities of those. The authority appoints the responsible bodies by considering the following factors.

- i. Consisting with serious issues of solid waste management.
- ii. Daily waste collection amount

By considering above mentioned two factors total of 33 local bodies (Kogyo Co 2016) authorized on collecting waste materials. The details including rubber wastage are tabulated in Table 1.

Table 2. Local government authorities collecting waste material

No	Province	Local authority	Rubber waste %	Waste rubber amount (kg/day)
1	Northern	Karachchi PS	0.2	12
2	Northern	Vadamarachchi PS	0.2	10
3	North-Central	Hingurakgodda PS	0.8	80
4	Uva	Kataragama PS	0.2	16
5	Southern	Hambantota MC	1.0	80
6	Eastern	Kinniya PS	0.6	36
7	Western	Kalutara PS	0.7	56
8	North-Central	Thamankaduwa PS	1.1	110
9	Northern	Jaffna MC	0.2	138
10	North-Central	Anuradhapura MC	0.3	75

11	Eastern	Trincomalee UC	1.0	260
12	Eastern	Batticaloa MC	0.4	240
13	North Western	Chilaw UC	0.2	36
14	North Western	Kurunegala MC	0.3	144
15	Central	Nuwara Eliya MC	0.4	84
16	Sabaragamuwa	Kegalle UC	0.4	60
17	Sabaragamuwa	Rathnapura MC	0.6	192
18	Uva	Badulla MC	0.4	112
19	Western	Gampaha MC	0.7	196
20	Western	Negombo MC	0.5	85
21	Western	Katunayake Seeduwa UC	0.6	140
22	Western	Kotikawatta Mulleriyawa PS	0.4	152
23	Western	Moratuwa MC	0.6	510
24	Western	Kesbewa UC	0.6	324
25	Western	Kolonnawa UC	0.4	120
26	Western	Maharagama UC	0.5	410
27	Western	Kaduwela MC	0.3	255
28	Western	Kalutara UC	0.4	80
29	Western	Beruwala UC	0.5	70
30	Western	Colombo MC	1.1	7750
31	Western	Dehiwela Mt. Lavinia MC	0.6	1020
32	Western	Sri Jayawardenapura Kotte MC	0.4	400
33	Central	Kandy MC	0.8	6240
Total				19477

(Kogyo Co 2016)

Analyzing the rubber waste amounts from each authority, three categories can be identified as follows.

Less than 100 kg per day: approximately 43% of all survey candidates

100-1000 kg per day: approximately 48% of all survey candidate

More than 1000 ton per day: approximately 9% of all survey candidate

Total of 19.447 ton of rubber waste collected in island wide from local authorities per day. Even though the percentage is very much low respect to other solid waste, rubber as a non-environmentally friendly material has huge impact on social health, environmental and to economy.. When Analyzing the provincial wise rubber wastage, western province has the highest wastage value of 11.512 ton per day and it is 59% from the overall value.

B. Survey on Private Collecting Institutes

Due to the heap of waste materials produced daily, private collecting institute are established to collect the waste materials all over the country. These institutes are governed by the local authorities and each and every institute should licensed under the CEA (CEA 2021a) Table 2 represents the total number of private collecting centers established in district.

Table 3. Licensed private waste collecting centers

District	Number of collectors
Colombo	79
Gampaha	29
Kalutara	24
Ratnapura	11
Kurunegala	6
Kandy	15
Hambanthota	07
Badulla	05
Puttalam	03
Matale	03
Matara	47
Kegalle	08
Galle	24
Trincomalee	06
Polonnaruwa	05
Vavuniya	02
Jaffna	06

Batticaloa	15
Ampara	01
Mulaithivu	01
Nuwara Eliya	01

(CEA 2019)

It is identified that 295 licensed private collectors in island wide, but it is important to mentioned that even though licence is approved to collect all non-hazardous waste materials, these collectors are more or less specified to collect three or four non-hazardous waste material. In that case, every collector does not collect waste rubber. Considering the waste rubber collectors, total of 400.19 ton per month collected in private institutes (CEA 2019).

C. Survey on Rubber Manufacturing Companies

Rubber manufacturing can be divided in several parts, with respect to their industry. However, rubber waste in manufacturing can be basically divided into two categories as tire rubber waste and latex rubber waste as represented in Table 3.

Table 4. Rubber wastage in manufacturing

Categories	Rubber waste (ton per month)	Percentage amount
Tire rubber waste	200	66.67%
Latex rubber waste	100	33.33%
Total	300	100%

Approximately, 300 tons of rubber waste generated per month in rubber manufacturing process and majority of that waste falls into tire rubber waste category (i.e. 50% increment compared to latex rubber waste). However, all these values are approximations and impossible to report exact values.

D. Survey on Rubber Manufacturing Companies

Summarizing the total wastage of rubber respect to the sources of collectors, different waste amounts can be observed. This variation in amounts can be explained as result of different number of sources, resources, industry specified on and capacity. The total rubber wastage amounts and respective percentages are summarized in Figure 2.

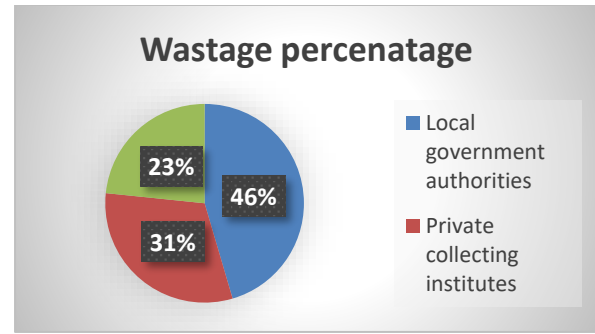


Figure 2. Waste percentages of institutes

Total of 1283.6 ton per month of waste rubber collected from all three sources. Out of the three sources, local government authorities have the highest amount of 583.41 with 45.451% of total. This can be explained by the higher resources and high number of collecting centers. It is worth to mentioned that, total of 63180 ton of solid waste materials are collected by local authorities (Kogyo Co 2016) per month and rubber wastage is 0.923% of the total.

IV. CONCLUSION

Survey on rubber wastage is a critical and timely need. With high environmental effect, to have an idea on rubber wastage collected daily is important. Also, to identify the sources to improve the facilities and to implement necessary actions are the advantages of the study while identifying the feasibility of using rubber crumb for concrete. The conclusion of the study is listed in below.

- The three main groups of rubber wastage collectors of Sri Lanka are local government authorities, Private collecting institutes and manufacturing companies as collectors.
- A total of 1283.6 ton of rubber waste collected per month from all three sources.
- The highest source of collector is the local government authorities with 583.41 ton per month with 45.451% of total.
- The approximate percentage of rubber waste from the total solid waste of the country is 0.34%.
- Sri Lanka available required quality of rubber wastage to use in rubberized concrete.

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