# Solid Waste Management in Locomotive using Crusher works on Wind Turbine

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**Abstract:** ***These days, Indian Railways is experiencing an extremely complex issue that is solid waste disposal in running trains because of more number of passenger travels and It is grievous to take note that a particularly enormous public vehicle framework doesn't have a legitimate waste administration framework set up. Because of the inefficient handling of the waste, there seriously affects the general climate across the rail organization. We can decrease solid waste by putting a crusher machine on the train which works on wind power. This paper brings additional opportunity for the creation of power by utilizing the idea of the turn of the wind turbine and using the power generated from the wind turbine to manage solid waste by using a crusher. However, these environmentally friendly power assets need to stand out enough to be noticed in the field of examination since it's as yet in the line of improvement and exploration.***

**Keywords:** Solid waste, Renewable wind energy, Moving train, Duct, Crusher

## 1. Introduction

The Indian Railways (IR) is the third biggest rail network on the planet with 66,000-course kilometers covering over 8000 stations. It is among one of the biggest and most established situations on the planet and appropriately called the "lifesaver of the country". It is the greatest public area undertaking in India and associates with the whole country. While the Railways is perhaps the most practical, helpful and harmless to the ecosystem methods of transport, one of the developing difficulties is that of waste administration. Around 23 million travellers travel by Indian Railway each day which brings about a tremendous measure of strong waste age. It is assessed that strong waste created. Out of this, significant commitment is to plastic waste.

## 2. Literature Survey

Mohit Sharma, Kanganika Neog, Rudresh Kumar Sugam and AditaRamji has explained the requirement of solid waste management [1].

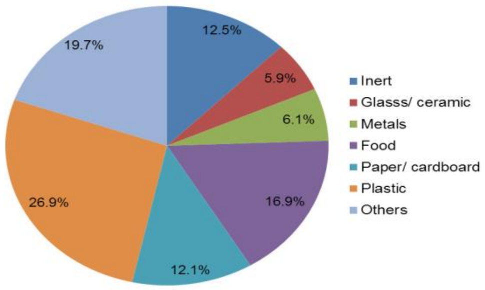


Fig 1 - Characterisation of solid waste[1]

Food catering units are the main centres of solid waste generation at railway platforms. A large number of recyclables, which are used for packaging food and beverages, also get generated as a result. Packaging waste includes paper, cardboard, glass bottles, metal cans and large amounts of various plastics. The Indian Railways needs a comprehensive strategy for the management of waste requiring efforts at different levels. To create an enabling environment, it should simultaneously leverage existing regulations, find synergies with national missions/policies, restructure existing institutional arrangements or create new institutions, wherever required [1].

Srinivasan S and Mr S. Lakshmi Narayanan studied the design and simulation of a wind turbine on rail coaches for power generation.[2]

**Theory**

Wind energy offers numerous benefits, which clarifies why it's the quickest developing fuel source on the planet. Current research efforts are aimed at addressing the challenges to the greater use of wind energy.

Smashers might be utilized to lessen the size, or change the structure, of waste materials so they can be all the more effortlessly discarded or reused, or to decrease the size of a strong blend of crude materials

There are two types of coaches on the Indian railway. ICF and LHB. ICF stands for "Integral Coach Factory" which is one of the railway's main coach production plants. The Integral Coach Factory is located in Perambur near Chennai. The ICF design refers to the conventional design of coaches seen across trains in India. In 1999, the railways imported a set of coaches from Linke-Hoffman-Busch (Now a part of Alstom) for testing and use in India. After a few glitches, they slowly began to gain popularity. Today, LHB coaches are manufactured by the Rail Coach Factory (Kapurthala) under a Transfer of Technology agreement. LHB coaches are characterised by a sleeker finish than ICF coaches, better suspension, sound reduction and ride quality, not to mention significantly larger windows that lack the heavy tinting seen in most ICF AC coaches. They are also safer than ICF coaches in the event of an accident or collision. LHB coaches are longer than ICF coaches, and seat layouts in LHB and ICF coach also different

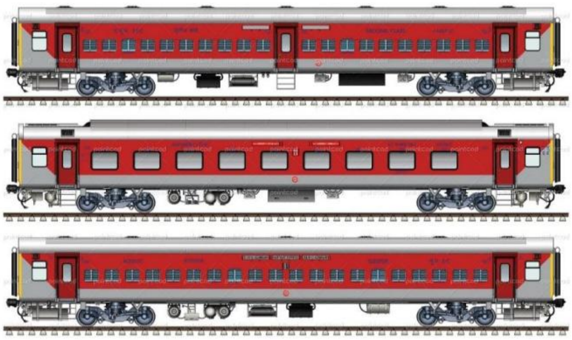

**Figure 2:** LHB Coaches

## 3. Problem Definition

There is lots of solid waste generated in trains while they are running and due to improper waste management in running train. passengers started through there waste outside from the windows or gate. This not only harms our nature but also for the peoples staying near the railway tracks. We can't blame the passenger for this problem because there is a very small waste bin is present in a coach and the railway can't have more space to place a big waste bin. The utilization of plastic items as packaging application in recent years has expanded the number of plastics in the strong waste stream generally. Other than being non-biodegradable in nature, removal of plastic squanders at landfill locales are perilous since harmful synthetic compounds filter out into the dirt and underground water and contaminate the water bodies

## 4. Methodology

The current framework is the most ideal option for this issue as expressed that the Kinetic energy of the wind is converted into mechanical energy through a wind turbine then this mechanical power store as electrical power in the battery as DC power. An inverter changes DC over to AC for different AC application. The Crusher machine used this power to run itself. There is a Crusher at the bottom of the wastebin so that whenever someone wants to through its solid waste on it. the crusher machine smashed the waste into small pieces and create a large space for storing more solid waste.

Wind turbine-
The following various variables:
E = Kinetic Energy (J)
ρ = Density (kg/m3)
m = Mass (kg)
A = Swept Area (m²)
v = Wind Speed (m/s)
C. = Power Coefficient
P = Power (W)
r = Radius (m)
dt/dm =Mass flow rate (kg/s)
x = distance (m)
dE/dt =Energy Flow Rate (J/s)
t = time (s)

Under constant acceleration, the kinetic energy of an object having mass (m) and velocity (v) is equal to the work done (W) in displacing that object from rest to a distance s under a force (F),

i.e. $$E = W = F*s$$

According to Newton's Law, we have:
$F = ma$
Hence,

$$E = mas \quad \dots (1)$$

Using the third equation of motion:
$v^2 = u^2+2as$
We get:
$a = (v^2-u^2)/2s$

Since the initial velocity of the object is zero, i.e. u = 0,
$a = v^2/2s$

Substituting it in equation (1), we get that the kinetic energy of a mass in motions is:

$$E = ½mv^2 \quad \dots (2)$$

The power in the wind is given by the rate of change of energy:

$$P = dE/dT = ½v^2 dm/dt \quad \dots (3)$$

As the mass flow rate is given by:
$dm/dt = \rho A dx/dt$

And the rate of change of distance is given by:
$dx/dt = v$
We get:
$dm/dt = \rho A v$

Hence, from equation (3), power can be defined as:

$$P = ½\rho A v^3 \quad \dots (4)$$

Betz limit-A German physicist Albert Betz concluded in 1919 that no wind turbine can convert more than 16/27 (59.3%) of the kinetic energy of the wind into mechanical energy turning a rotor. To this day, this is known as the Betz Limit or Betz' Law. The theoretical maximum power efficiency of any design of wind turbine is 0.59 (i.e. no more than 59% of the energy carried by the wind can be extracted by by a wind turbine).

This is called the "power coefficient" and is defined as:
Cmax =0.59

Also, wind turbines cannot operate at this maximum limit. The C. value is unique to each turbine type and is a function of the wind speed that the turbine is operating in. Once we incorporate various engineering requirements of a wind turbine - strength and durability in particular – the real world limit is well below the Betz Limit with values of 0.35-0.45 common even in the best-designed wind turbines. By the time we take into account the other factors in a complete wind turbine system - e.g. the gearbox, bearings, and generator and so on - only 10-30% of the power of the wind is ever actually converted into usable electricity. Hence, the power coefficient needs to be factored in equation (4) and the extractable power from the wind is given by:

$$P = ½ñAv^3C \quad \dots (5)$$

Duct design-
Considering drag force the duct inlet is designed as small as possible so that it makes maximum use of inflowing air.
Inlet air velocity = vehicle velocity (km/hr)
From the continuity equation,
$A_1 V_1 = A_2 V_2$
$L_1 \times b_1 \times V_1 = L_2 \times b_2 \times V_2$
Where $A_1$ = area at the inlet of duct.
$V_1$= inlet velocity (air) in duct
$A_2$= area at outlet of the duct.
$V_2$= outlet velocity (air) from the duct.

## 5. Result and Discussion

There is a waste bin that exist downside of the washbasin in LHB coaches. Now we have to place a crusher machine at the bottom of the train just down of the waste bin. The crusher is run by using renewable energy i.e. wind energy. A duct wind turbine is used for this model to control the amount of air inlet to the turbine to provide safety for the wind turbine blades from the variation of the speed of the train. The wind turbine is placed on the top of the train and its shaft is connected to a dynamo that charges the battery and the crusher machine get power from that. The size of the turbine blade is more than the conventional wind blades so that it can increase the output torque and decrease the rotational speed of wind blades, high torque is used to crush the solid waste easily.

## 6. Conclusion

We can effective utilizing wind energy in running train by placing a wind turbine. The capability of the wind turbine as a machine that converts the kinetic energy of wind into mechanical energy to crush the solid waste produced in Indian rails. Which reduces solid waste categorized as biodegradable, slowly degradable and non-biodegradable and provide a pure environment-friendly waste disposal system. Nowadays, many of the train coaches do not have proper dustbins and also there size is very small which fills up very soon, So that people throw wastes like plastic bottles, carry bags, food remnants, disposable cups and plates, etc. through the windows and doors of the coaches. But after placing the crusher machine large amount of solid waste can be stored in the crushed form in trains which can easily pick up at the last destination station of the train.

## 7. Future Scope

We can use an excess amount of power generated through the wind energy in the moving train coaches to make it better. We can provide 220V of power in the charging point which can charge mobile phones, laptop, etc. to eliminate the current problem regarding the excess amount of current comes on the charging point. it leads to burn the charging sockets.

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