**Production calculation in non-hazardous waste recycling facility**

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| **Abstract**  In this study, packaging waste collection, separation and pressing work is carried out in a business located in Çankırı. Packaging wastes from various productions are first weighed from the scale and discharged into the collection area. Here, the same size is passed through the appropriate number of separation belts. Packaging wastes from the separation belt are collected in prepared boxes. After the collection separation, it goes to the pressing belt. After the pressing process, the packaging waste is sent to the temporary storage area and the recycling facility. It is offered for sale to companies that are in special demand. Packaging waste, which is defined as non-hazardous waste, is used in the facility. Wooden packaging, metallic packaging, composite packaging, glass packaging, textile packaging wastes are also evaluated in the facility. Since heat treatment is not used in the facility, there is no harmful transfer that will cause air emissions. Despite the fact that domestic wastewater is generated at the facility, it is exempted from "wastewater discharge". The annual production amount, press calculation and necessities of the facility were calculated.  |
| Keywords: Packaging waste, Production capacity, Waste collection, Waste separation  |

1. **Introduction**

Recycling is a current issue. Waste and pollution are of great importance to humans, the environment and society. For this reason, it concerns the individual, the smallest part of society, and ultimately the whole society. With the increase in industrialization, the world quickly faced this problem[1].

The definitions of waste and garbage are often confused. Not recycling has a negative impact on all living things. The waste collected during recycling is separated in the sorting center and processed into plastic, glass, paper, etc. It is classified as. Additionally, waste management is important in a sustainable economy. Garbage is an unwanted product that is no longer possible to use and cannot be recycled. Waste is defined as a material that is produced during industrial production and also as a result of consumption, and that can be recycled and used again in production. Most importantly, it is necessary to understand that "not all waste is garbage" and improve our evaluation perspective accordingly. Efforts to eliminate garbage or waste depend on the development level of societies. For this reason, all stages from the formation of garbage or waste to its collection, transportation, storage and processing require a certain work [2].

In Turkey, waste was defined for the first time in the Environmental Law No. 2872 dated 1983 as "harmful substances thrown or released into the environment as a result of any activity"[3].

Solid garbage that is an environmental and social problem; Within the waste cycle, from the moment they are produced to the final disposal step, they interact directly or indirectly with the environment and society. On an important issue, the increase in global warming, the decrease in energy resources and the resulting environmental pollution in the process of obtaining waste materials such as glass and paper constitute an important problem [4].In a study, there are various approaches for classification of waste. Solid garbage is divided into seven subheadings when separated according to where they occur. These; They are stated as domestic solid waste, industrial waste, hazardous waste, agricultural and garden waste, medical waste, special waste, construction residue and rubble waste [5].

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**1.1 Zero waste**

The waste management strategy called zero waste has come to the fore in solid waste management. Zero waste is a management system that guides waste management efforts to eliminate waste on-site and prevent problems in burning and storing waste, and to reduce and eliminate waste at its source.

Zero waste is an inevitable fact that existing waste consumes natural resources by using water and electricity and creates pollution in terms of environment, soil, air and water. For this reason, it can be described as achieving a waste-free production and consumption structure. In short, minimizing waste is the process of resetting and reviewing resource use [5-7].

In the Zero Waste Regulation published in the Official Gazette No. 30829 dated 12.07.2019 in Turkey, zero waste; "An approach that aims to protect the environment and human health and all resources by preventing/reducing waste generation in production and consumption, prioritizing reuse, collecting the waste generated separately at the source, and reducing the amount of waste to be sent for disposal by ensuring recycling and/or recovery"; The zero waste management system is; It is defined as "a management system created by taking into account the benefit and cost factors, starting from the prevention of waste generation, reducing waste, segregating it at the source, temporary storage, separate collection, transportation and processing" [6-10].

In the current company, plastic, paper, cardboard, etc. obtained from the environment. The products are separated on the sorting band and sent to the pressing machines. Scrap paper and cardboard are pressed as secondary products in pressing machines. Baling was done by adjusting the bale size in the horizontal press machine. Plastic scrap is a secondary product and is pressed in a vertical press. As a result of the chronometry study carried out on the horizontal press machine, it was determined that the loading of 1 bale was completed in 2 minutes. In the chronometry study performed on the Vertical Press machine, it was determined that 1 pallet of product was removed from the press and strapped in 20 minutes. Capacity calculation was made by evaluating the separation process according to its capacity.

**2.** **Materials and Methods (Times New Roman 12-Bold)**

**2.1 Annual production amounts:**

Capacity calculation is calculated as 300 days and 8 hours per year. The efficiency was taken as 0.80. There is one separation band in the facility with a length of 10 m and a band width of 1 m (Equation 1).

B: 10 m ( belt lenght ) E: 1 m ( bandwidth ) H: 5 m/d belt speed

Ya: 0,3 m waste height on belt

$V belt: B x E x Ya x K $ : 10 x 1 x 0,3 x 0,8 = 2,4 m3  (1)

$V waste: Vbelt x H/B $ : (2,4 x 5 / 10 ) x 60 = 72 m3/hour

 Total amount of separated waste per day (Equation 2).

$Vdaily: 72 x 8 $ = 576 m3/day

Annual total amount of separated waste (2)

$Annual: 572 x 300 $= 172.800 m3/day

**2.2. Press account**

Scrap paper and cardboard Secondary Products:

$K : (60/2) x 8 x 300 x 0,8 $= 57600 piece/year (3)

1 bale of paper and cardboard is 1.6 x 1.2 x 0.9 in size (1.728 m3). Although there are differences in the weight of the waste product, the average pressed weight of 1 m3 of scrap paper and cardboard is 140 kg..

$ K: 57.600 x 1,728 $= 99.532 m3/year x 140 kg / 1000 = 13.934 ton/year (4)

 99.532 m3/year /300 day = 331,77 m3/day

**2.3. Scrap plastic secondary product:**

$K : (60/20) x 8 x 300 x 0,8 $= 5.760 piece/year (5)

1 plastic bale is 2x1x1 in size (2 m3). Although there are differences in the weight of the waste product, the average pressed weight of 1 m3 of scrap plastic material is 110 kg. Its average weight is 220 kg.

$K: 5.760 x 2$ = 11.520 m3/year x 110 kg = 1.267 ton/year (6)

 11.520 m3/year /300 day = 38,4 m3/day

Separation capacity and press capacities were examined separately and production values were taken according to the press capacities.

**2.4. Need items:**

Scrap Paper and Cardboard = 5% excess (due to foreign material)

 13,934 X 1.05 = 14,630 ton/year

Scrap Plastic = with 5% excess calculation (due to foreign material)

 1,267 x 1.05 = 1,330 ton/year

Plastic strap = 12 meters are used in 1 bale

 (57,600 + 5,760) x 12 = 760,320 m/year

**3. Results**

The company produces 13934 tons/year of scrap paper secondary product (Equation 3-4) and 1267 tons/year of scrap plastic secondary product (Equation 5-6). Annual consumption is calculated as 14630 tons of paper and cardboard waste, 1330 tons of plastic waste, and 760320 meters of plastic straps.

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