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APPROACHING THE CIRCULAR ECONOMY IN ROMANIA - A HIGHER ALTERNATIVE TO THE LINEAR ECONOMY

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Abstract: *The main purpose of this paper is, on the one hand, to carry out a statistical analysis about the degree of preoccupation with the circular economy at national level through activities carried out in accordance with the legislative requirements imposed on the European level and on the other hand, the realization of a case study on the possibilities of optimizing the technical and economic activity of a commercial company in terms of environmental and resource protection considerations as a model for putting into practice the theoretical concept of circular economy. In order to make the analyzes possible regarding the circular economy concept and how it is understood and applied in Romania country, at the macro level, it has been utilized the existing indicators from a national public database, and at the micro level, for the purpose of carrying out a case study on the optimization of the washing activity of the means of transport, in the context of the circular economy, it were used the data provided by the commercial urban transport company that has been analyzed.* ***Keywords:*** *circular economy, linear economy, waste management, resource consumption, industrial waste, reuse of wastewater.*

1. INTRODUCTION

The originality of the paper consists in identification the possibility of reducing the level of pollution resulting from the use of technological water from a commercial company in the washing process, but at the same time to find the optimal solution to invest, reduce or give up the amount of water supplied by the municipal network.

In a circular economy, the value of products and materials is kept as many as possible; waste and the use of resources are minimized, and resources do not leave the economic flow once they have reached the end of their lifetime but are reused and create value [1, 2]. Research in the field of circular economy is intended to serve both of the economic, environmental and social progress of individuals in the Globe and the business environment and is being used to increase economic and social efficiency, welfare and the rise of civilization [3,4].

The materials and method are based for the most part on the statistical analysis of the existing data in accordance with identification the level of achieving the goals based on transcending from the linear to a circular economy in Romania. At the same time, it is necessary to identify the rank of Romanian peoples concern about reducing consumption of energy or consumable resources, in accordance with "greening" concept implementation and economy growing possibilities, based on the European Union requirements expressed through specific indicators [5]. According to this, the research carried out in this article wants to reveal the methods by which what we call today waste, tomorrow, can turn into a new product that has other uses. But until the final user (the individual / citizen), who has to adopt a behavior specific to the circular economy, after he understands and realizes the importance of this aspect, the activities carried out by the commercial companies (public or private operators, industries, etc.) can be regulated by the development of circular economy models, by finding a bridge between the legally binding obligation (in the process of finalizing) and the own initiatives of the economic operators, by adopting specific policies and benefiting from the advantages they bring [6].

According to the latest reports of the European Commission, Romania is at the last places in terms of waste recycling rate. So, after 2020, the main goal for Romania is to close the resource loop and the country's circular economy is mandatory to look like figure 1 [7].

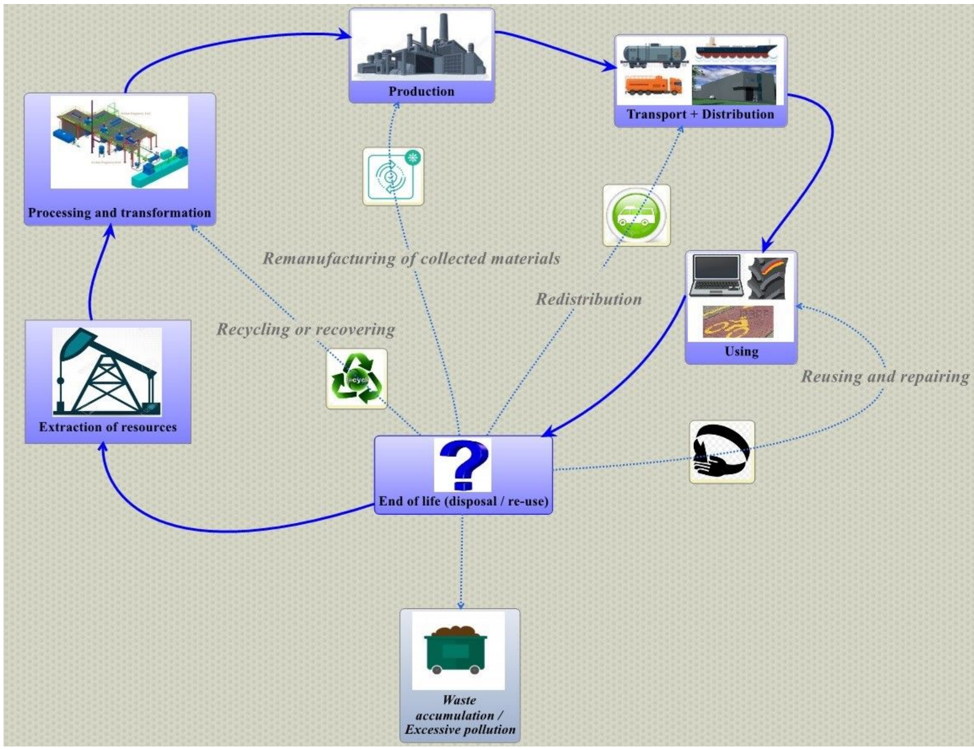

Fig. 1 Permanent resource flow

2. STATISTICAL ANALYSIS FOR THE CIRCULAR ECONOMY ACTIVITIES AT THE MACRO LEVEL

In the last years, in order to see the level of use of resource consumption, it was taken data from the National Institute of Statistics [8], more exactly data on industrial waste generated by producers, and statistical data on the municipal waste recycling and collection rate. The first indicator - the industrial waste rate, expresses the total amount of waste generated by the main economic activities: mining, manufacturing and energy. The second indicator - the municipal waste recycling and collection rate - expresses the degree of recycling of municipal waste from the amount of municipal waste collected.

According to figure 2, averaging three years, it can be noticed that in the first place, from the point of view of waste generation, the extractive industry has the first rank with the highest growth rate in 2012 and 2013 respectively. On the second place is the energy industry, with the highest increases being recorded in 2009 and 2011. Last but not least, it was observed that the manufacturing industry, whose only apparent growth over the rest of the years, registered it in 2007, and will keep then its annual waste generation below 30,000,000 tons per year.

About industry, it can be said that it pollutes absolutely all environments - air, water, soil, causing damage to the health of humans, livestock, agriculture, transport, construction, culture and themselves too [9].

Polluted waters spilled into the natural ones produce an increase in the content of heavy metals, coal dust, various inorganic and organic chemicals. The energy industry has a thermal, aural, electromagnetic, chemical and aesthetic environmental pollution because it contributes 57 % to the greenhouse effect because it emits 55 % of the total CO_2, 15 % of CH_4 (methane) and 6 % of NO_2 (nitrogen dioxide) [10].

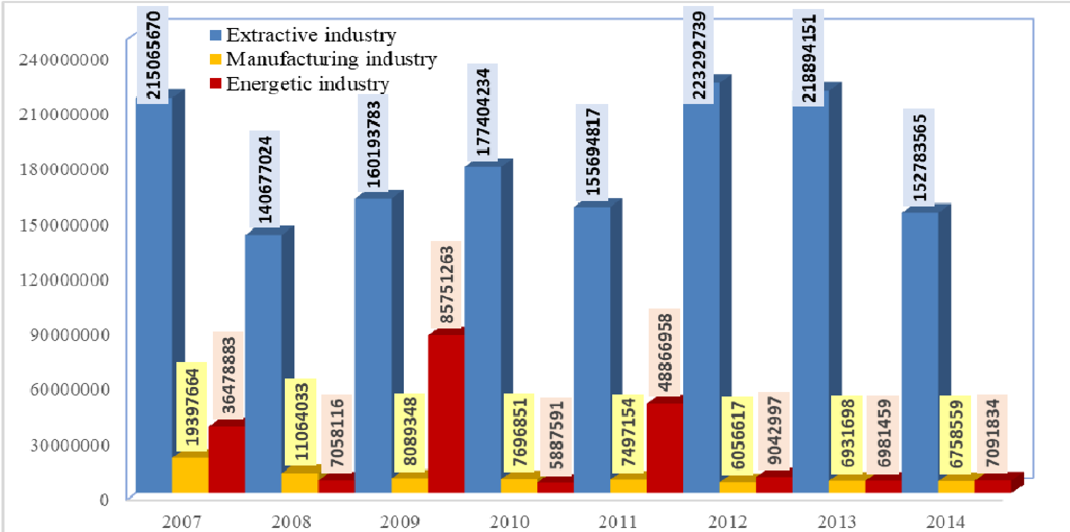

Fig. 2 Industrial waste generated

From the figure 3, it can be noticed that the years which most municipal waste was collected are 2007 to 2010, so the following years decreasing continuously. In contrast, an inversely increasing proportion is found in the recycling of waste - if in the first three years, from 2007 to 2009, recycling was almost non-existent, starting in 2010, it marked a considerable increase but did not managed to exceed the threshold of 2,000,000 tons.

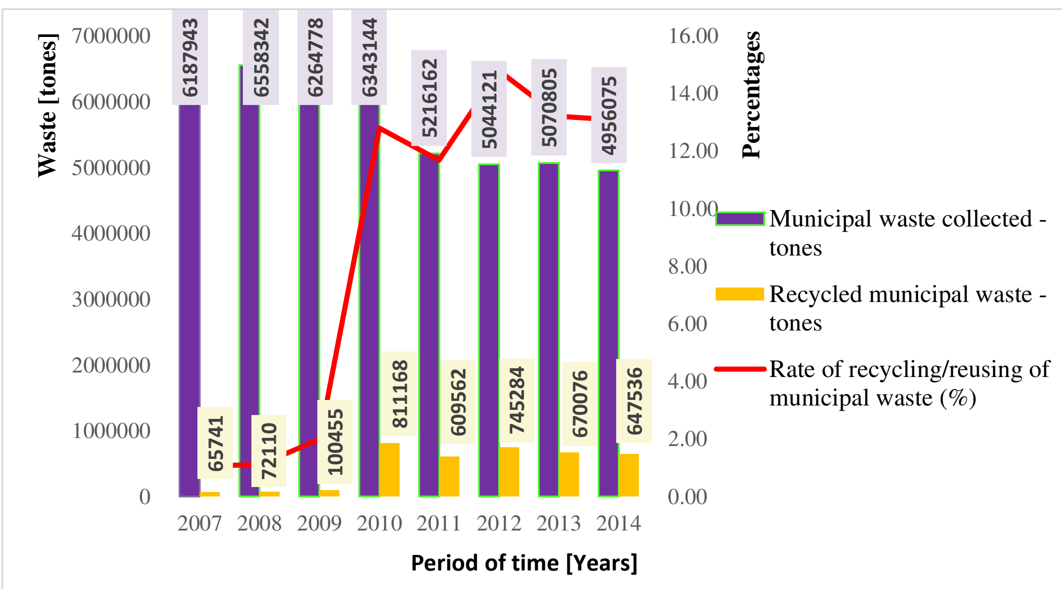

Fig. 3 Municipal waste collected and recycled

So, according to the chart exposed in figure 3, the municipal waste recycling rate is the most significant, with 14 % of the total waste collected, which is not at all encouraging, because it means that the remaining 86 % will have the final dump garbage collection of cities [11].

Although the analysis of the results presented in figure 3 shows that the municipal waste recycling / reuse trend has been increasing in recent years, however, only approximate 13 % of the waste produced is recycled / reused.

Given the fact that water is one of the precious natural resources and also the fact that waste water is one of the main municipal waste produced, a leap on the possibilities of its re-use shows a major interest.

Regarding the reuse of household wastewater produced by households, we can say that in 2019 we are dealing with a long-lasting process with relatively small results, not due to the lack of technology (which is also available), but rather, taking into account psychological factors, proper education and moralizing with effects on user awareness.

The possibilities for reuse the wastewater as a result of industrial processes, are promising and the technology is much easier to implement, with important beneficial results on the economic prospects of wastewater generators as well as on environmental protection by decreasing the level of pollution directly by discharging wastewater as waste, but also by reducing the needs to use water supplied by the municipal network [12].

Thus, a case study was carried out in order to identify the possibilities for reusing of wastewater resulting from the bus washing activity of a transport company whit an own fleet.

3.CASE STUDY ON IDENTIFYING THE POSIBILITIES FOR REUSE OF WASTEWATER USED IN A CAR WAH SECTOR PART OF A TRANSPORT COMPANY

The main purpose was to identify the possibility of reducing the level of pollution resulted from the use of technological water in the washing process, but at the same time finding the optimal solution to invest, reduce or give up the quantity of water supplied by the municipal network, to clean vehicles in the analyzed transport fleet.

Therefore, starting from the analysis of the sub-process of washing the means of transport, included in the maintenance process of the car fleet owned by a transport company, there was identified a washing unit for the enlarged transport vehicles (buses, minibuses), equipped with high pressure washer equipment with a 15 l / min consumed water flow, as well as the disposal of waste water (resulting from vehicle cleaning / washing) by means of a collecting channel and evacuation to a settling basin.

The technological flow of the transport company is presented in figure 4, where it is presented a sketch of the emplacement which highlights the water networks, also of domestic sewage and rainwater, as well as the utilities related to the car wash, intended to prewash the technological water used.

With regard to the waste management resulting from the washing of the means of transport, the main types of waste identified are waste water contaminated with petroleum products and slurries, namely sludge and sand (20 03 04 CODE).

The amount of waste in the form of sludge produced is 0.031 m^3 / day and 0.93 m^3 / month, and the amount of waste in the form of wastewater is $Q_{uz/day/med}$ =1,5 m^3/day.

The flow of meteoric waters is calculated with the relation (1):

$$Qm = (SC \cdot 0,85 + SN \cdot 0,05) \cdot K \qquad (1)$$

where: Q_m = the quantity of meteoric water calculated and invoiced (m^3 / month);

0,85 – drainage coefficient for built-up areas (SC);

0,05 – drainage coefficient for unbuilt surfaces (SN);

K = the specific amount of meteoric water communicated by the NMA (National Meteorological Administration).

It results Qm = 0,12 l / s discharged into the rainwater gutter network from the area.

From the perspective of water quality protection, technological effluents of possible contaminated technological waters are represented by the indicators in table 1.

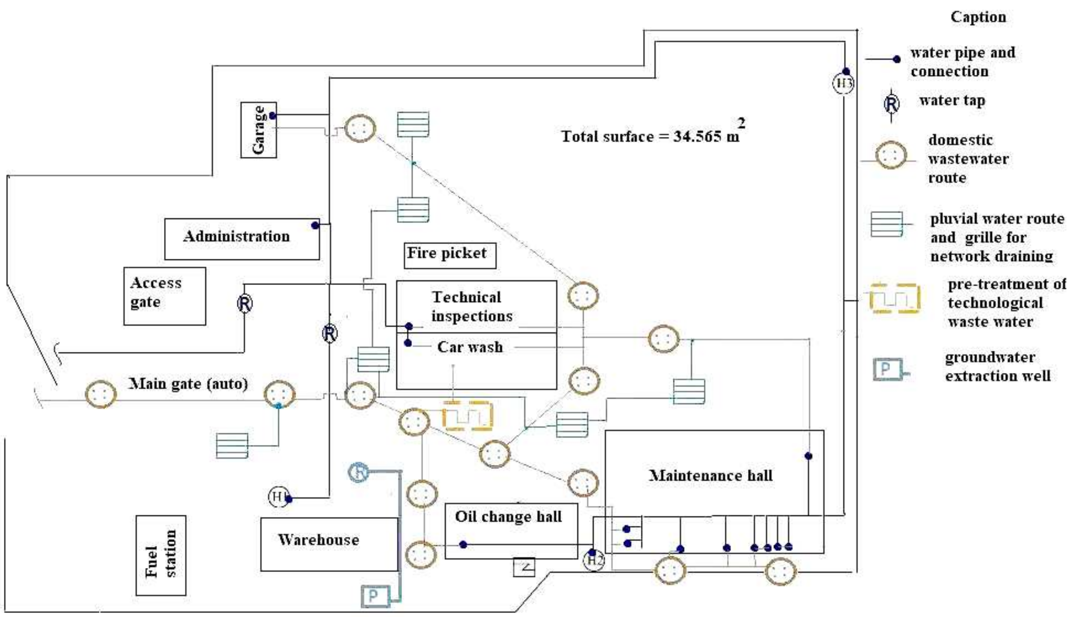

Fig. 4 Distribution of water and wastewater networks

Therefore, starting from the possibility of applying the concept of circular economy, it was proposed the following two optimization solutions for the car wash activity analyzed in the case study:

1-Extracting fresh water from the ground through a drilling rig from a drilling well;

2-Equipping the existing decanter with a proper final treatment system and reuse of purified water.

In the case of the first solution, using a centrifugal pump or drilled water installations (pipes, fittings, valves), a quantity of water can be drilled from the groundwater, which serves as an excess of the water used in the current network, for washing the means of transport.

Tab. 1 Technological effluents of wastewaters

Source	Pollutant	Mass flow; g/h	Concentration; mg/l	NPTA 002/2002; mg/l
Decanter output	*pH*	-	6,84	6,5-8,5
	CCO-Cr	0,343	1,03	500 mg O_2/l
	suspension	11,36	34,1	350
	extractable	0,166	0,5	20
	detergents	-	-	25

Calculation of the total intake of drip water is determined with relation (2):

$$K_{total(annual)} = Q_{time} \cdot \eta_{functioning} \qquad (2)$$

where:

$K_{total(annual)}$ = the amount of annual drilled water used;

Q_{time} = hourly flow rate of drilled water (according to figure 4) [m^3/h];

$\eta_{functioning}$ = hours of operation (8 h/day x 365 days);

$$K_{total} = 2 \cdot 2920 = 5840 \ m^3 .$$

Considering a minimum price of 3 lei / m^3 of water (the average of the prices practiced by the largest national water companies), the water used for washing the transport vehicles, obtained from the municipal network, by using this underground water drilling equipment, yearly results in cost reduction, determined by relation (3):

$$C_{water(washing\,buses)} = 3\,lei \cdot 5840 = 17{,}520\,lei\,/\,year \quad (3)$$

The fixed costs of purchasing the equipment, the necessary elements for commissioning (pipelines, valves, etc.), installation costs and maintenance costs in accordance with the sales and labor prices of the main suppliers and operators are determined by the relation (4):

$$C_{fixed} = C_{acquisition} + C_{auxiliary} + C_{assembly} + C_{maintenance(contract)} \quad (4)$$

$$C_{fixed} = 5500 + 4600 + 2000 + 5000$$

$$C_{fixed} = 17.100\ lei$$

where:

$C_{acquisition}$ = purchase costs;

$C_{auxiliary}$ = cost of commissioning;

$C_{assembly}$ = installation cost of the equipment;

$C_{maintenance(contract)}$ = total maintenance costs stipulated by contract (500 lei/year · 10 years).

The analysis shows that the investment amortization period is ≈ **1 year.**

A second solution, which has as its starting point the possibility of applying the concept of circular economy regarding the reuse of the technological wastewater resulted from the process of washing the means of transport, is the equipping of the decanter with a final water treatment system.

To analyze the effectiveness of the investment in this solution, a comparative study compared to the first solution was performed, referring to the annual amount of water used by adopting such optimization. Thus, for K total (yearly) = 5840 m^3 of water consumed and discharged into the decanter (of which about 10-15 % sludge residues, respectively 850 m^3) and the annual costs of washing the buses

$$K_{washing} = 17.520\,lei\,/\,year - (850\,m^3 \cdot 3\,lei) =$$

$$= 17520 - 2550 = 14.970\,lei, \textit{result the relation}\,(5):$$

$$C_{fixed} = C_{acquisition} + C_{auxiliary} + C_{assembly} + C_{maintenance(contract)} \quad (5)$$

$$C_{fixed} = 7500 + 500 + 10000$$

$$C_{fixed} = 18.500\ lei$$

Observation: $C_{maintenance(contract)}$ *- include consumables (filters, cartridges, etc.).*

The analysis shows that the investment amortization period is ≈ **1.23 years**.

It can be observed that the depreciation period of the two equipment's is relatively close, justifying the investment of any of these.

Considering that sludge waste together with other types of effluent existing in the technological water resulting from the washing of the means of transport represents 10-20 % of the total amount of waste resulting, the degree of reuse of the water used for the purpose of technologically-washing transport vehicles (ponds, platforms, etc.) is R(reuse) = approx. 80 %.

4.CONCLUSIONS

Circular economy is the opposite of the linear economy - the classic production and consumption model, which is still widely used in Romania. The concept could be the solution to the problems that exist today in both Romania and the entire economy of the world.

The results show to the one hand, a classification of the industry categories with regard to the generated waste quantity and on the other hand, the recycling rate determined by the municipal waste collected level.

Based on the result obtained, it can be concluded if Romania make some steps to adopting a circular economy model and understanding the importance of reaching European Union indicators, but also implementing a collective consumers' behavior for product circularity as ways for perform a sustainable economy in accordance with increase healthy level and a good life style for the population of this country.

It can be said that the circular economy is a continuous positive development cycle that keeps and increases natural capital, optimizes resource efficiency, minimizing systemic risks by managing finished stocks and renewable flows [13].

The results of research carried out in this paper, shows that in Romania, the extractive industry has the highest growth rate of waste production, with over 223 tons of waste by a year. On the other side, it was find that the energy industry has a contribution of 57 % to the greenhouse effect.

Moreover, from the technical and economic analyzes carried out in the case study, it results that the depreciation period of the investment of one of the two equipment is between 1-1,24 years. It is a relatively short period, so that the advantages brought with the decision to acquire and use such an installation are not only those based on considerations of reducing the pollution of the environment by failing to take into account the water treatment measures used, but also economic, by using at the minimum level or at least zero the water from the municipal network for washing the means of transport.

As a result of the two identified solutions it can be stated that it is necessary to focus the management of the company to invest in the ground water drilling equipment, toward the final cleaning of the waste water resulted from the washing of cars, decision which, with the depreciation of this investment, offers significant savings on the use of technological water and, last but not least, it facilitates the fulfillment of the environmental requirements specific to waste reduction and the company's enrollment into a circular economy that supports the environment through the effective development of economic activity.

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ABORDAREA ECONOMIEI CIRCULARE ÎN ROMÂNIA - O ALTERNATIVĂ SUPERIOARĂ ECONOMIEI LINIARE

Rezumat: Scopul principal al acestei lucrări constă pe de o parte, în realizarea unei analize statistice a gradului de preocupare în legătură cu economia circulară la nivel național prin activități desfășurate în conformitate cu cerințele legislative impuse la nivel european și, pe de altă parte, în realizarea unui studiu de caz privind posibilitățile de optimizare a activității tehnico-economice a unei societăți comerciale în ceea ce privește considerentele de protecție a mediului și a resurselor ca model pentru punerea în practică a conceptului teoretic al economiei circulare.

Pentru a face posibilă analiza conceptului de economie circulară și modul în care este înțeleasă și aplicată în România, la nivel macro, au fost utilizați indicatorii existenți dintr-o bază de date publică națională, iar la nivel micro, pentru efectuarea studiului de caz ce vizează optimizarea activității de spălare a mijloacelor de transport, în sensul economiei circulare, au fost folosite datele oferite de către societatea comerciala de transport public urban analizată.

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