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RECOVERY AND ENERGY SAVINGS OF ALUMINUM CAN BEVERAGE CONSUMED IN GENERAL AND VOCATIONAL – TECHNICAL HIGH SCHOOLS

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Abstract: *In commitments of Kyoto protocol principles, 100% recyclable features aluminum is one of most current metal. In this protocol, Turkey is not contractor to develop policies to prevent climate change to apply, to take measures to increase energy efficiency and savings, to limit greenhouse gas emissions. Aluminum production from used aluminum requires 95% less energy than production from raw material and recycled aluminum put in the production reduces flue gases pollutant emissions at rate of 99%. Between 2004-2005 and 2009-2010 academic year education is estimated that every one of 5 and 10 students were consumed average 1 aluminum can beverage each day to take into account habits of general and vocational high school students. In case of recovery of 50% this cans will save approximately 4.7 and 13.1 million kWh electrical energy, in the case of 75% recovery will save between 7.2 and 19.9 million kWh electrical energy, in the case of 100% will save the 9.4 and 25 million kWh electrical energy than the same amount of aluminum in the primary method (from ore) in our country. In the same conditions is estimated that realization of an efficient recycling project will provide between 5.2 and 20 million kWh of electrical energy savings in the 2010 -2011 academic year education. In this study, anymore it turned into a habit of recovery of packaging waste application in most countries as the name "Blue Angels Project" to place in our country has been trying to bring clarity to issues.*

Keywords: Aluminum can, recovery, energy saving, Blue Angel Project

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I. INTRODUCTION

Aluminum, the commercial production of which started approximately 110 years ago, has been produced much more than the total sum of copper, tin and lead that have been used for ages by the humankind. Being placed in III A section of the periodic table and having the atomic number 13, aluminum has a high melting (660°C) and boiling (2450°C) temperature. Available as compounds in nature, aluminum is the third most abundant element following oxygen and silicon with its presence around 8 % within the crust of earth. Today the supply of aluminum has reached more or less 30 million tons along with the recycled (secondary) aluminum. Despite its lightness, when alloyed, aluminum has sufficient strength, a high corrosion resistance and can reflect heat and light. Aluminum can also be shaped and used over and over again. These features are placed aluminum in an advantageous position in various areas. With these features it possesses, aluminum has a good deal of use in transportation sector, packaging industry, electric-electronic industry, construction sector and beverage cans. [1,2]

80% of the fruit juice and acid-containing beverage metal boxes in the world are made out of aluminum. Compared to the other metals, aluminum is almost 100% recyclable and thereby it has ecological advantages that will make aluminum a metal of the future. If energy is 20 units to produce a new can form bauxite ore, required energy for producing from scrap is one unit at the same conditions. This means that producing aluminum from scrap necessitates 95% less energy than production of aluminum from raw material. Criteria such as usage of the limited resources in our world in a most economical, least pollute to the environment and consuming the least energy make aluminum more advantageous over the alternative materials. Collecting and recycling programs are developing rapidly owing to the factors such as high usage rate, increasing public awareness, and the support of the aluminum producers. This case is especially valid for the countries where the high market share of aluminum recycling encourages investments in projects. Some western countries called this process as “Blue Angel Project” which recycling takes place effectively within the life cycle. In these sorts of projects, it is important to determine where, how, when and by what kind of vehicles to pick the packing wastes; where to separate them; where to put the recycled products into good use; how to educate the consumers; the opinions and criticisms of consumers; raising the awareness of the gatherers; how to rehabilitate the gatherers on the street through the system; the advantages that will be attained by collecting the packing wastes; the responsibilities and aims of the releasers of the products, municipalities and community. [1-5]

Production of aluminum is divided into two part; primary (from ore) and secondary production (from scrap). In primary aluminum production, bauxite of the aluminum ore ($Al_2O_3.nH_2O$) is carried through in 6 stages:

bauxite mining, the production of alumina (Al_2O_3) from bauxite ore, the production of liquid aluminum from alumina through electrolysis, alloying of the liquid aluminum; the casting and forging of the casting products. The production of alumina from bauxite ore in the production of aluminum is executed through Bayer Process. In this process, the ore is reacted with NaOH at high temperature and pressure and then the alumina within the ore is placed into the solution and then precipitated with impregnation. The extracted residue is calcined at 1100 – 1200 °C. In this way, aluminum production was carried out. [1-5]

In the primary aluminum production, the stage in which most energy is consumed and emissions that are harmful to the environment is the electrolysis where carbon anodes are used. At this stage, as a result of the resolution, dissolution and reduction of alumina in cryolite-aluminum fluoride molten salt solution which is named as electrolyte at the temperature of 960 - 970 °C under high current in the cells of aluminum electrolysis, the neutralized aluminum metal accumulates to the bottom end of electrolysis cell and taken from to be cast in mold. And at the end of all these procedure steps, 2 tons of alumina and a ton of aluminum are acquired from approximately four tons of bauxite. Throughout the world average 15268 kWh/ton electric power is utilized in the production of primary aluminum. [1-4,6]

In the production of secondary aluminum includes such processes as scrap collection, classification and preparation, melting, refining and alloying. First the grubby, painted or coated waste aluminum is put onto the tread-wheel in the process of recycling of aluminum that can be re-used over and over again. Then along the conveyor aluminum passes through some big magnets and so steel or other metals present in the waste are separated. Aluminum cans and materials that are separated from the other materials are compressed. Compressed aluminum is sent to the manufacturing plant. In next stage, painted and oiled scrap materials are cleared of paint and oil for raising of the melting level, preventing the contamination of the liquid metal and reducing the emission. Scrap aluminum is put through pre-heating in order to get rid of the humidity. Afterwards these cleaned scraps are heated up about 700°C in the melting furnace. Molten aluminum cumulates at the bottom of the aluminum cell and then cast into molds. Following a variety of processes they are utilized again in the production of aluminum cans and other aluminum materials. [1-3]

The purpose of this study is present the power saving that will be obtained only through recycling of can beverages in the general and vocational-technical high schools which are the institutions that environmental awareness is created.

II.METHODS

In this study, the number of the secondary education students and can beverages consumed by them has been estimated by taking their fast food eating habits into account was determined and also considered the principle of not to encourage students to drink acidic beverages in all of these calculations. The number of students attending General and Vocational-Technical High Schools and the number of days when they must be at school determined by the academic calendar of the Ministry of National Education between the education periods 2004 – 2005 and 2009 – 2010 was given Table 1. The estimated number of students for the 2010 – 2011 terms is also added to the Table 1.

In the literature studies related to the subject, it is confirmed that the students consume at least one canned beverage as a result of their habits of eating out, their need for snack between the meals and the TV commercials [8,9]. In the light of this information, two scenarios were created by economic factors and school-student profiles are taken into consideration. In the first scenario, it is assumed that at least one of the five students in the schools consume one aluminum can (Al) per day during an education period. According to this first scenario, the number and amount (ton) of aluminum can are figured up.

In the second scenario, on the other hand, in accordance with the student profile that has relatively more regular eating habits and that have nutrition awareness, it is assumed that at least one of the ten students in the schools consume one aluminum can (Al) per day during an education period and the number and amount (ton) of aluminum can are calculate accordingly. Finally, recycling of the determined amount of aluminum and the electric power saving that might be obtained in accordance with the production of the same amount of aluminum in the primary method (from ore) are computed in kWh. In this calculation power savings that will come out if 50 %, 75 % and 100 % of the aluminum is recycled are presented.

The amounts and incomes when the project is put into practice in 2010-2011 are also included in the scenario.

III.RESULTS

The calculations regarding the number of cans that are gathered out of the scenarios envisaged by means of the total work days on which the students in General and Vocational-Technical High Schools will be at school between the education periods 2004 – 2005 and 2009 – 2010 are given in the Figures. The calculated results on the number of students predicted in the 2010 – 2011 period are also included in the Figures. As part of the first and the second scenarios envisaged through the presumption that one out of 5 students (G-1/5, V-1/5) and one out of 10 students (G-1/10, V-1/10) attending general high schools and vocational-technical high schools consume 1 aluminum (Al) can beverage per day throughout the whole education period, the number of consumed aluminum cans is given in Figure 1.

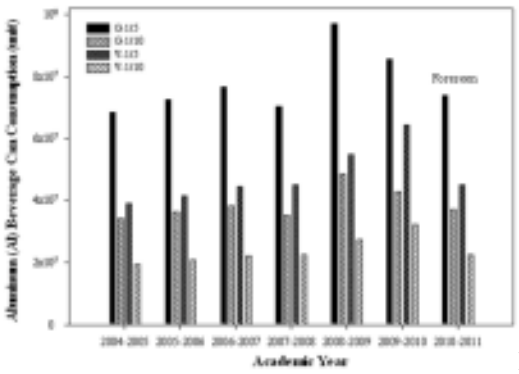

Fig. 1. The number of consumed aluminum cans for education periods

Moreover, considering the fact that one empty aluminum beverage can weighs about 12.5 grams, total amount of aluminum is given in Figure 2.

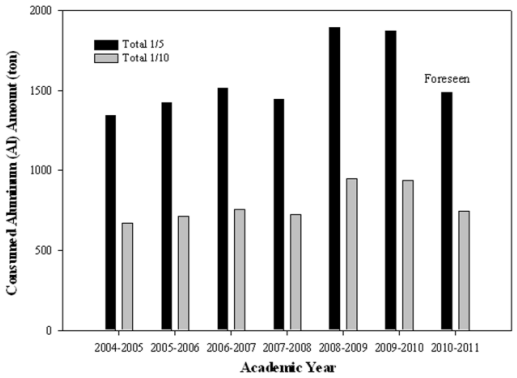

Fig.2. Amount of consumed aluminum (tons) for education periods

In the process of aluminum recycling, it is known that approximately 14000 kWh/ton electric power will be saved in comparison to the primary production. The power savings that can be obtained in the case that the recycling project is effectively applied on the predicted consumptions (1/5 and 1/10) and the 50 %, 75 % and 100 % of the total consumption is effectively recycled in general and vocational-technical high schools during the education periods in question, 2010 – 2011 prediction of the savings to be made once the Project has been realized is given in the Figure 3.

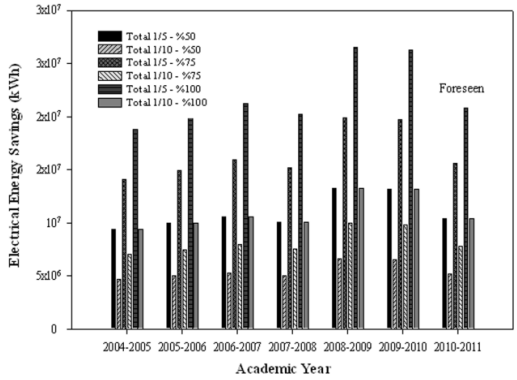

Fig.3. Electrical energy savings that the 50 %, 75 % and 100 % of the total consumption is effectively recycled in academic years

IV.CONCLUSION

As the world's energy resources are rapidly being depleted, decreasing the use of raw materials and recovery and recycling of metals are currently considered as the most rational and essential methods. In the case that an effective recycling project is carried out between 2004 – 2005 and 2009 – 2010 education periods (even if 50 % of the potential amounts to be consumed are recycled) approximately 4.7 and 13.1 million kWh electric power is estimated to be saved. In the education period 2010-2011 it is predicted that 5.2 and 20 million kWh electric power will be saved under the same conditions once the project is realized. When an aluminum beverage can is recycled and used in the aluminum production, the electric power consumed by a 100 kWh lamp in 3,5 hours or by a TV in 3 hours is saved [3]. Once this Project is comprehensively understood throughout the country, both the environmental awareness and power saving will be realized, too. Moreover, this potential saving is not limited only to the electric power. When the used aluminum is recycled, bauxite resource is simultaneously saved. Once 1 kg of aluminum can is recycled, 8 kg bauxite and 4 kg chemical substance is saved at the same time [3].

In the literature studies it is determined that higher education students who are normally expected to have more awareness and who also have a relatively permanent eating habits, have similar consumptions too [9]. While the in situ recycle kiosks in the EU countries function properly, the importance of educational institutions in the acquisition of similar habits in our country may also be seen in this study.

Considering all these advantages of recycling, it becomes apparent that the process of recycling the

packing wastes should be carried out as a Project [3]. While the projects like Blue Angel that are introduced in developed countries provide principles such as power saving, preservation of natural resources and decreasing the amount of waste, the inadequacy of the industrial facilities in our country that will utilize these scraps in the production process must be considered thoroughly. Similar projects must be put into practice and carried into action throughout the country with the participation of both municipal administrations and non-governmental organizations and especially Ministries of Education and Environment.

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Education periods	Number of Days	Number of students	
		General High School	Vocational and Technical High School
2004–2005	177	1937055	1102394
2005–2006	175	1937055	1182637
2006–2007	179	2142218	1244499
2007–2008	178	1980452	1264870
2008–2009	175	2771900	1565264
2009–2010	177	2420691	1819448
2010–2011	176	2103745(foreseen)	1276885(foreseen)