8. ULUSLARARASI ERCİYES BİLİMSEL ARAŞTIRMALAR KONGRESİ



KONGRE KİTABI

EDİTÖR

PROF. DR. MUSTAFA TALAS

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01-02 EKİM 2022

KAYSERİ

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8. ULUSLARARASI ERCİYES BİLİMSEL ARAŞTIRMALAR KONGRESİ

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01.10.2022
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OTURUM: 1 SALON: 1 / MODERATÖR
Dr. Öğr. Üyesi Mahir AKGÜN

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Hatice Gizem ŞAHİN Assoc. Prof. Ali MARDANİ	Bursa Uludağ Üniversitesi	EFFECT OF USING NANO-MATERIALS IN 3D PRINTING CONCRETE MIXTURES, A REVIEW
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Arş. Gör. Dr. Abdullah Göçer İsmet Aydın YILMAZ Prof. Dr. Mehmet Baki Karamış	Erciyes Üniversitesi	ÇİFT CİDARLI HİBRİT KOMPOZİT MALZEMELERİN MEKANİK ÖZELLİKLERİNİN ARAŞTIRILMASI
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Sercan YALÇIN	Adıyaman Üniversitesi	EVRİŞİMSEL SİNİR AĞLARI KULLANILARAK PANKREAS KANSERİNİN TEŞHİSİ

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MANDALİNA ATIKLARINDAN ELDE EDİLEN PELETLERİN BAZI FİZİKSEL PARAMETRELERİNİN BELİRLENMESİ

DETERMINATION OF SOME PHYSICAL PARAMETERS OF PELLETS OBTAINED FROM MANDARIN WASTE

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ÖZET

Ülkemiz bir tarım ülkesi olması sebebi ile tarımsal faaliyetler sonucunda büyük miktarlarda tarımsal atık açığa çıkmaktadır. Bu tarımsal atıkların bir kısmı değerlendirilmekte bir kısmı ise atıl olarak arazide çürümeye bırakılmaktadır. Bu çalışmada, ülkemizde tarımı yapılan mandalina bitkisine ait atıkların pelet olarak değerlendirilebilme olanakları araştırılmıştır. Bu amaçla açığa çıkan bu atıklar pelet olarak değerlendirilmiştir. Elde edilen peletlerin ortalama nem içeriği %4.7, pelet yoğunluğu 1260 kg.m^{-3}, pelet sertliği 3036.83 N, mekanik dayanıklılık direnci ise %90.13 olarak hesaplanmıştır. Ayrıca bu peletler için baca gazı emisyon değerleri belirlenmiştir. Elde edilen sonuçlara göre mandalina tarımsal atığından elde edilen peletlerin, hem fiziksel özellikler hem de çevresel faktörler bakımından oldukça uygun olduğu tespit edilmiştir.

Anahtar Kelimeler: Tarımsal atık, pelet, mandalina, emisyon

ABSTRACT

Our country is an agricultural country, large amounts of agricultural waste are generated as a result of agricultural activities. Some of these agricultural wastes are evaluated and some of them are left to rot in the field. In this study, the possibilities of using the wastes of the mandarin plant cultivated in our country as pellets were investigated. For this purpose, these wastes were evaluated as pellets. The average moisture content of the pellets obtained was 4.7%, the pellet density was 1260 kg.m^{-3}, the pellet hardness was 3036.83 N, breaking resistance 94.36%. and the mechanical strength resistance was 92.14%. In addition, flue gas emission values were determined for these pellets. According to the results obtained, it has been determined that the pellets obtained from mandarin agricultural waste are quite suitable in terms of both physical properties and environmental factors.

Keywords: Agricultural waste, Pellets, Mandarin, Emissions

INTRODUCTION

From the earliest times of humanity to the present, biological origin resources are among the leading renewable resources used for energy production. Pellet from processed products is the modernized form of biofuels. Biofuels are cheap and renewable energy sources where raw materials can be obtained from local sources. Biomass is an important energy source, as it still constitutes the fourth largest energy source in the world. Many developed countries see biomass

energy as the main energy source of the future, for example, Finland obtains 20% of its energy from biomass, Sweden 16% and Austria 13%. Biofuels constitute the highest potential source in meeting the energy need of our country, which meets the majority of its energy needs through imports and is expected to increase gradually. Citrus is grown in large quantities in our country. Citrus; It is a plant community that includes Citrus genus fruit tree species with high economic value such as citrus, orange, mandarin, grapefruit, bergamot and lemon. According to FAO data, citrus fruits were produced in approximately 8.6 million hectares of land in the world in 2020. In the world, 45% of citrus production areas are orange, 35% tangerine, 15% lemon and 4% grapefruit. In the same year, Turkey realized citrus production on an area of 157,833 ha. Since it is mostly used in fruit juice production, 47% of the 103 million tons of citrus production in the world in the 2021/22 production season is orange (FAO, 2020). Considering the amount of mandarin production in citrus cultivation in our country, 1 million 819 thousand tons of mandarin production was realized in 2021. 84% of this production was met from the Mediterranean and 15% from the Aegean Region.

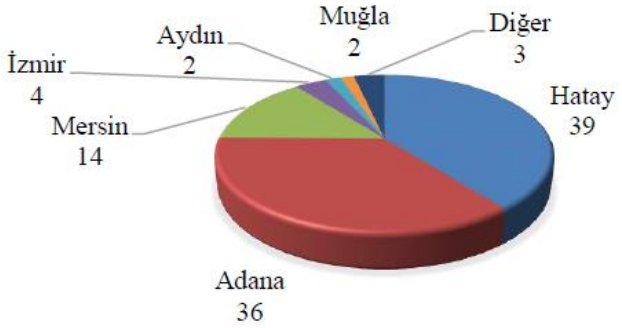


Figure 1. Important Provinces in Turkey's Mandarin Production (%) (TUİK, 2021)

In our world where fossil fuels are decreasing and their environmental impacts are increasing, it is very important to evaluate such agricultural wastes and to meet some of our energy needs. In order to minimize the effects of global warming and climate change, it is recommended that less than half of the greenhouse gases emitted should be released (IPCC, 2000). Biomass energy, which has a great place in new and renewable energy sources, is perhaps the most important of the sources that can provide it without polluting the environment and sustainably (Başçetinçelik ve ark., 2005; Başçetinçelik ve ark., 2009a; Başçetinçelik ve ark., 2009b). In order to make this biomass waste usable in various applications, it is necessary to solve the problems related to biomass (Karkania ve ark., 2012). Since agricultural wastes are materials with low density and high moisture content, direct burning in homes and industrial areas is not very effective, and direct use of these wastes is not economical during transportation, storage and processing stages. In addition, their storage in the environment in bulk causes soil, air, water and visual pollution (Tosun ve ark., 2002). Pelleting is one of the methods used to increase the density of biomass. With the pelleting process, problems related to transportation costs, storage and use of biomass can be overcome (Karkania veark., 2012). By burning pelleted biomass, it burns longer, gives off more heat and is cleaner (Prochnow ve ark., 2009).

The aim of this study is to make pellets using mandarin wastes grown in our country and to determine some physical properties of the pellets obtained.

MATERIAL AND METHOD

The experiments were carried out in Ondokuz Mayıs University and Çukurova University, Faculty of Agriculture, Department of Agricultural Machinery and Technologies Engineering

Biomass Laboratory. Mandarin wastes (Figure 2) were used as material in the experiments. Mandarin wastes were obtained from Adana and Mersin growing enterprises.



Figure 2. Pre-fragmentation and chopping of mandarin wastes

Up to date European standards (EN 14961-2 & EN ISO 17225-6) were taken as a reference for this research. The pre-fragmented and chopped material (Fig. 2) was sun-dried under normal conditions until their moisture content was reduced to M10 (8-10 %).

Then the dried material was ground in a 3-kW electric hammer mill consisting of 8 hammers rotating at a speed of 2,850 rpm (Fig. 3). Once The pellets were ground to a particle size of 8 mm. Moisture contents were re-measured, and the particles were pelleted using a pelleting machine (Fig. 4). Particle density of pellets were calculated according to standard (EN 15150, 2011). As defined in that standard the volume of the cylindrical properly shaped pellets was calculated by stereo-metric method and the averaged volume is proportioned to the average mass of the pellet ($g.cm^{-3}$). Likewise, the bulk density was calculated as defined in the particular standards (EN 15103, 2009). Mechanical durability of the pellets was tested according to standard (EN 15210-1, 2009). In this test 500 g of test portion is placed into this rotating chamber. It's rotated 500 times at 50 rpm speed and then the sample is removed and weighed again. The weight difference before and after the test gives us the mechanical durability of the pellets. Pellet firmness parameter is important during transportation and storage of pellets. The firm-ness values were determined with a special device (Fig. 5).



Fig. 3 Grinding Fig. 4 Pelleting Fig. 5 Pellet firmness tests

As for the thermal properties, lower heating value of pellets were determined by a calorimeter according to the instructions given in standard (EN 14918, 2009). Before testing, the pellets were disintegrated in a shredder and kept at 105 ºC for 24 hours to remove the moisture. The flue gas emissions like O_2(%), CO (ppm), CO_2(%), NO(ppm), NOx(ppm) were measured and recorded with a gas analyser.

RESULTS AND DISCUSSION

The average length of the pellets produced in 8 mm diameter is 27.76 mm, and the average weight of the pellets varies between 0.65 and 1.23 g. Pellet particle density was obtained by dividing the weight of each measured 40 3-replicated pellets by the pellet volume. The pellet diameter determined from the research is between the limits specified for the pellet diameters (6-8 mm) specified in the manual used for the certification of wood pellets for heating purposes prepared by the European Pellet Council (EN16127). On the other hand, it has been determined that all pellet lengths are within the limits given for the pellet lengths specified in the EN16127 standard (3.15-40 mm). The density of pellets varied between 1260 kg/m^3 on average. (Table 1).

Table 1. Physical and chemical properties of pellets

Mechanical durability (%)	92.14
Breaking resistance (%)	94.36
Material bulk density (kg/m³)	100.61
Pellet bulk density (kg/m³)	474
Pellet density (kg/m³)	1260
Pellet moisture content (%)	4.77
Pellet firmness (N)	2807.4
Calorific value (Mj/kg)	18.66
Ash content (%)	5.64

The selection of tests related to the quality of the pellets (strength resistance, breaking resistance and compression tensile strength) varies depending on the forces encountered during production and use. The correct test should estimate well the forces generated during the transport and storage of the pellets (Kaliyan ve Morey, 2009). To establish the exact criteria for the strength and durability of the biomass pellets, the climatic conditions of the transport, storage and the place where the pellet is transported must be taken into account (Khoshtaghaza ve ark., 1999). Vinterback (2002) reported that the amount of pellet losses, strength resistance and bulk density are important pellet quality parameters and that high toughness resistance is necessary to reduce losses in pellets. The average strength resistance of the pellets obtained in this study was calculated as 92.14%. Many researchers reported that this similarity could be achieved by dropping the pellets from a certain height to certain surfaces (Pietsch, 2002; Sah ve ark., 1980; Khankari ve ark., 1989; Shrivastava ve ark., 1989; Al-Widyan ve Al-Jalil, 2001). When the fracture resistance values of the pellets were examined, the breaking resistances changed between 94.36% on average. If the pellet strength values are 80% and above, it is considered as high quality, between 70-80% as medium quality, and below 70%, the pellet quality is

considered as low quality (Tabil and Sokhansanj 1996, Tabil and Sokhansanj (1997). 100% LKT is in the low-quality class and the other mixtures are in the middle and high-quality class

Ash content of the pellets made from mandarin agricultural residue was found as 5.64%, which is in line with the reference value (A10≤10%) given in standard (EN ISO 17225-6, 2015). Heating value of pellets was found as 18.66 $MJ.kg^{-1}$. That is also compatible with the value (Q14.5≥14.5 $MJ.kg^{-1}$) indicated in the above-mentioned standard. The results showed us that the heating value of pellets produced from orange tree pruning residues are higher than the wood (17.57 $MJ.kg^{-1}$). That is a promising result especially, when the huge idle potential is concerned. The flue gases of the pellets are presented in Table 2., below.

Table 2. Flue gas emissions of pellets Water content after burning (%)

CO(ppm)	NOx(ppm)	SO2(ppm)	CO2(%)	O2 (%)	NO (%)
1007,33	112,67	7,67	5,50	15,40	107,33

All the measured emission values were in the limits given in Regulations for Air Pollution Control (*IKHKKY, 2014*).

CONCLUSION

Energy is the biggest issue on today's world. Renewable energy is a good choice for that since it' sustainable. Biomass energy from agricultural residues is very promising since it's everywhere and environmentally friendly, too. Knowing the physical properties of biomass pellets is very important especially in terms of transportation, storage, transportation processes and incineration systems. Utilization of idle mandarin residues as source of solid biofuel in the form of pellets were investigated in this study. The pellets were produced with 8 mm PS and M10 moisture content. Thermal properties of fuel pellets such as lower heating value, ash content and flue gas emissions were determined. All the tests were done according to the latest EU standards. The results showed that the fuel pellets have very good thermal properties as a fuel. Besides, as from the environmental point of view flue gas emissions were within the defined limits. The increase in such research will accelerate the evaluation of organic wastes and contribute to the implementation of pelleting studies more effectively.

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