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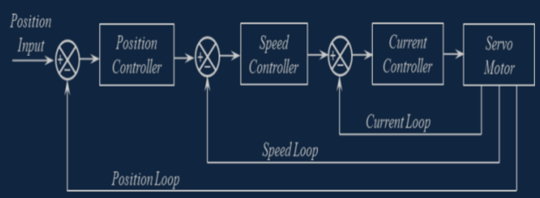

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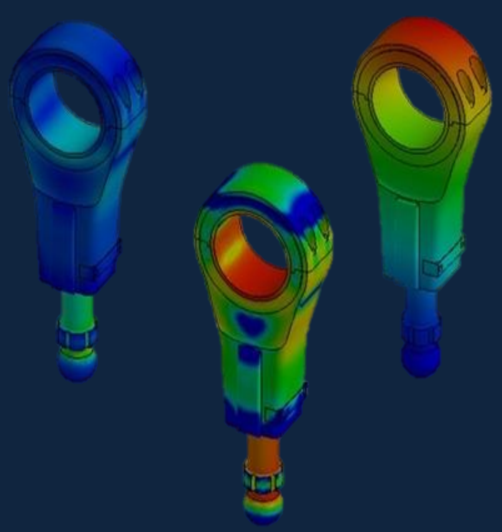

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PREFACE

Dr. Recep HALICIOGLU (Editor-in-Chief)

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The effect on hardness and density of filling materials in NR/SBR rubber compounds

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ABSTRACT

The effects of SBR and NR compounds on characteristics of different filing were examined. Natural rubber (NR RSS3) and styrene-butadiene rubber (SBR 1502) were used as the main matrix material. New compounds were formed by replacing the fillings in the general compound of the existing factory (SiO_2, $CaCO_3$) with 10 % blast furnace flue dust, rice husk, reclaimed rubber (recycled) and wood ash. Comparison of the new compounds with the existing compounds revealed a decrease in hardness and density.

1. Introduction

Natural and artificial rubbers are widely used in various industries, particularly in shoe sole making, due to their superior properties. For the product that will be obtained from these materials to have the required properties, many filling and additive materials having various properties are added during the process. A review of the literature have shown that various materials such as mica powder, wollastonit, glass sphere, glass fiber, nanoclay, calcium carbonate, talk, carbon black are used as filling materials. High cost of filling materials has led the people to seek cheaper filling materials. The reason for adding particle reinforced fillings to rubber material in appliances was generally to produce the desired commercial elastomers [1].

Şahin Y.M. showed that superior rheological and dynamic mechanical properties can be obtained by the use of composites in which grinded waste rubber (reclaimed rubber) is replaced with certain ratios of carbon black, when compared to those that only contain carbon black [2].

Savaşçı et al., reported that bending capability, failure strength, hardness should be enhanced while material cost should be reduced to achieve the desired properties in the use of filling materials in elastomers [3].

Ichazo et al., studied the effects of wood ash on rheological, mechanical and wearing effects in NR compounds. They compared the values with those obtained with carbon black. The researchers used 15-30% wood ash as filling material in NR. They reported that materials with a grain size of 250–300 μm did not deteriorate wearing properties; they increased failure strength and that wood ash can be used as a semi-reinforcing filling material in NR composites [4].

Sumaila et al., analyzed tensile, compressive and impact resistance values by adding 2-10% peanut husk powder (wood cellulose) into polyurethane material. They reported that as the quantity of filling material increased, tensile strength increased as well. They also reported that filling material had a negative impact on impact resistance. As the quantity of filling material increased, a decrease was observed in impact resistance. They found that 4% filling material gave the best result in compressive strength, while 8% filling material gave the worst result. In conclusion, the researchers reported that it can be used as a filling material in polyurethane [5].

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Akçakale et al., analyzed the effects of mica powder on NR/SBR type elastomer based materials. They reported that material type, type of filling material and grain size were important parameters on mechanical properties [6].

In a study on rheological behavior of mineral fillings in shoe sole materials, Jolene et al., used 10% mica powder or 10% glass sphere instead of calcium carbonate ($CaCO_3$) in SBS block copolymer and studied the changes in mechanical properties of the material. They reported that glass sphere yielded the best result (5.8 MPa); calcium carbonate ($CaCO_3$) filled composite gave the value of 5.49 MPa and mica powder filled mixture gave the value of 5.41 MPa. In elongation at break tests, glass sphere filled composite gave the value of 630, calcium carbonate filled composition gave the value of 685; mica powder filled mixture gave the value of 650. As for the hardness values of the obtained SBS copolymer composites, they reported that all three materials were identified as 62 Shore A; wearing ratios of glass sphere filled materials, calcium carbonate ($CaCO_3$) filled materials and mica powder filled composites were found to be 273 mm3, 307 mm3 and 378 mm3 respectively. Tearing strength values of glass sphere, ($CaCO_3$) and mica powder filled composites were found to be 25 N/m, 23 N/m and 24 N/m respectively [7].

Mohan et al., reinforced NR/SBR rubber with nanoclay filling and analyzed the effects on mechanical and thermal properties. The researchers observed that as % weight ratio of nanoclay increased, hardness increased as well, however, cold tearing strength decreased [8].

Prasertsri et al. studied NR/SBR composite ratios and the effect of t transition temperature of silica (SiO_2) materials on these composites. The highest t transition temperature was determined in alloys which contained equal amounts of NR/SBR rubbers. They observed that t transition temperature increases as % weight ratio of Silika (SiO_2) increases [9].

El-Nashar et al., used modified phosphate instead of carbon black. They observed that mechanical properties improved and vulcanization times decreased [10].

In a study conducted on the compounds formed by adding different phosphates to the NR/SBR matrix material, it was stated that the most appropriate mechanical test results were obtained from the NR and SBR compounds at the rate of 75/25. It was indicated that the different phosphate types added to the compound in addition to the carbon black decreased the vulcanization time while significantly increasing the mechanical properties (tensile strength, percentage elongation, hardness and tearing strength) [11].

Mohan et al., examined water intake property of nanoclay filling support to NR/SBR rubber structure and observed that increases in nanoclay weight amount decreased temporal water permeability properties of the rubber [12].

In this study, apart from conventional filling materials, we used different waste materials (non-recyclable) as filling materials. The aim of this studies the effects of filling materials on hardness and density properties in rubber compound materials.

2. Experimental

2.1 Materials used in rubber preparation

The NR RRS3 natural rubber and SBR 1502 Styrene Butadiene rubber were bought from Defne Kauçuk Import and Export Co. Ltd. Turkey. Silica (SiO_2), Kalsit ($CaCO_3$), blast furnace flue dust, reclaimed rubber and wood ash were purchased from Petkim Inc., Miner Madencilik Co. Ltd., İron-Steel Factory of Karabük, Selçuk Rubber Co.Ltd. and Kafkas Etliekmek Co. Ltd. Turkey, respectively. The other rubber compounding ingredients used in the study were obtained from Defne Kauçuk Import and Export Co. Ltd., Turkey.

2.2 Preparation of raw rubber

NR-SBR rubbers and fillers were compunded in a laboratory type banbury (Farrell brand) at 80 ^{o}C and 60 rpm for 10 minutes. Then, blast furnace flue dust, rice husk, reclaimed rubber and wood ash were added at the rates of 10 % wt. into the NR/SBR rubber compounds. After blending, the blend was left to rest for 24 hours. The dough was then blended in a two-roll open mixer at 80 ^{o}C and at a speed of 40 rpm for 5 minutes, followed by addition of additives such as softeners, activators, vulcanization, accelerators and sülfür, and stirring was continued for 3 minutes. The usage rates of fillings and additive materials added into the compounds are given in Table 1.

2.3 Vulcanization of rubber compounds

The rubber compounds were cut in small pieces, placed in a 180x180x6 mm mold that could be compressed by press (Hidrosan) device for 160 ºC at 5 minutes under 16 MPa pressure and the compounds were vulcanized under the same conditions. All the tests were performed after the compounds were cut into the standard dimensions according to relating test standards and were kept in an environment having 50 % relative humidity at 25±2 ºC for 24 hours. The hardness measurement of the vulcanizates was conducted by using a Shore A durometer (Commerciale, AFFRI 3001 model) according to ISO 868. Densities of the compounds were measured in line with Archimedes Principle (ISO 2781).

Table 1.Composition of rubber compounds.

FILLING MATERIALS	% phr				
	G	WA	RH	RR	BFFD
NR	50	50	50	50	50
SBR 1502	50	50	50	50	50
Calcite	26.6	-	-	-	-
Silica	33.4	-	-	-	-
Wood ash	-	10		-	-
Rice husk	-	-	10	-	-
Reclaimed rubber	-	-	-	10	-
Blast furnace flue dust	-	-	-	-	10
POACHERS					
Zinc oxide	3	3	3	3	3
Sulphur	1.5	1.5	1.5	1.5	1.5
Stearic acid	1.5	1.5	1.5	1.5	1.5
[a] PEG 4000	2	-	-	-	-
ACCELERATORS					
[b] DM	1	1	1	1	1
[c] CZ	1	1	1	1	1
[d] DPG	1	1	1	1	1

[a] Polyethylene Glycol
[b] Dibenzothiazole disulfide
[c] N-Cyclohexyl-2-benzothiazole sulfenamide
[d] Diphenyl guanidine

3. Results and Discussion

Hardness test results were conducted according to ISO 868 norm. It was observed that the hardness of G compound was 65 Shore A. The lowest hardness value was observed in RH (40 Shore A), while the highest hardness value was observed in WA 49 Shore A (Figure 1).

Results of the tests that were performed according to ISO 2781 density methods. Density should not exceed 1,5 g/cm^3 according to international standards. Although the density of the G compounds was 1,2 g/cm^3, density values of new compounds varied between 1,03 g/cm^3 and 0,96 g/cm^3. It was found that RH (rice husk) had the lowest density and the density of RR (Reclaimed rubber) decreased by 18,3 %. Density of BFFD (blast furnace flue dust) formulae deceased by 1,02 g/cm^3-% 15. Even the density of WA (wood ash) formulae which had the highest density, decreased by 1.03 g/cm^3- % 14,1.

4. Conclusion and Further Suggestions

Test results showed that new filling materials which replaced SiO_2 and $CaCO_3$ reduced density. The lower density values are, the lighter the shoe sole will be as the volume will remain unchanged. Hardness value slightly decreased when compared to G compound.

Varying ratios of wood ash, rice husk, blast furnace flue dust and reclaimed rubber materials can be added to G compound without removing SiO_2 and $CaCO_3$. Rice husk can be used in NR/SBR type rubber shoe soles by furnacing and adding their dust.

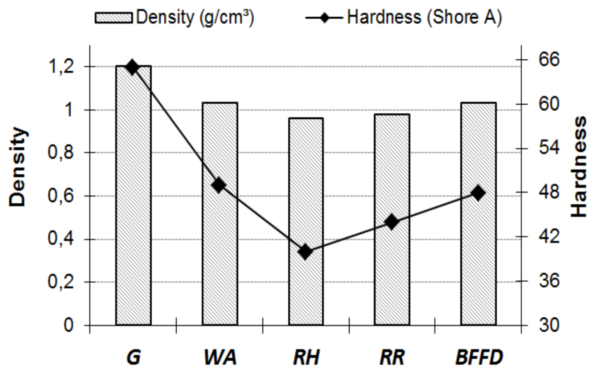

Figure 1. Density and hardness of carburized corncob ash filling compounds.

In this study not only in shoe soles but also rubber materials used in interfaces in machines of new filling materials

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Investigation of hydrogen production cost by geothermal energy

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ABSTRACT

Geothermal energy has a significant potential on hydrogen economy where it can contribute sustainable production of hydrogen by renewable energy sources. In this paper, using geothermal electricity in hydrogen production by electrolysis is investigated. The cost of producing one kg of hydrogen by electrolysis as functions of temperature and mass flow rate of geothermal fluid for steam and binary cycles is studied. The analysis is based on an economic model of geothermal power production. The results show that the cost of hydrogen is inversely proportional to both the geothermal resource temperature and mass flow rate.

1. Introduction

Geothermal energy is the thermal energy within the earth's interior. Geothermal energy is used to generate electricity and for direct uses such as space heating and cooling, industrial processes, and greenhouse heating. High-temperature geothermal resources above 150°C are generally used for power generation. Moderate- (between 90°C and 150°C) and low-temperature (below 90°C) geothermal resources are best suited for direct uses such as space and process heating, cooling, aquaculture, and fish farming [1]. With the increasing scarcity of fossil fuels and increasing concerns over the environmental problems they cause, the use of renewable energy resources will likely increase and diversify. Geothermal energy appears to be a potential solution where it is available to some of the current energy and environmental problems, and a key resource for making society more sustainable [2].

Geothermal energy provides an affordable, clean method of generating electricity and providing thermal energy. Geothermal power plants tap certain high-temperature resources to generate electricity with minimal or no air emissions. The common types of geothermal power plants are dry steam, single- and double-flash, binary, and flash/binary cycles.

Hydrogen is considered by many to be a potential replacement for fossil fuels [3]. The total cost of producing hydrogen depends on production, liquefaction, storage and distribution costs [4]. Today approximately 9 billion kilograms of hydrogen are produced annually. More than 95% of the merchant hydrogen is used for industrial applications in the chemical, metals, electronics, and space industries. There are several methods used to produce hydrogen. These methods include: natural gas reforming, electrolysis, liquid reforming, nuclear high-temperature electrolysis, high-temperature thermo-chemical water-splitting, photo-biological, and photo-electrochemical. Steam methane reforming accounts for 80% of the hydrogen produced. Electrolysis is the process of making a non-spontaneous process occurs by applying an external power supply to the application. A number of existing and planned demonstration projects are using or will use electrolysis, even though it is one of the more energy intensive processes for producing hydrogen. However, it provides a pathway for producing hydrogen from carbon free renewable energy [5].

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Hydrogen provides the connecting point between renewable electricity production and transportation, stationary and portable energy needs. When the electricity from solar photovoltaics, wind, geothermal, ocean and hydro technologies is used to produce and store hydrogen, the renewable source becomes more valuable and can meet a variety of needs. In transportation applications, hydrogen provides a way to convert renewable resources to fuel for vehicles. Renewably produced hydrogen for transportation fuel is one of the most popular hydrogen economy goals, as it can be domestically produced and emissions free [6].

Honnery and Moriarty [7] investigated wind power at the global scale in an attempt to assess the potential for future hydrogen production. Hydrogen generation is done via low-pressure electrolysis and transmission via high-pressure gas pipelines. Naterer et al. [8] examined the potential of electrolysis and thermochemical hydrogen production to serve both decentralized needs with production during off-peak hours, and centralized base-load production from a nuclear station, respectively.

Despite the existence of numerous investigations on the use of renewable energy sources for hydrogen production, reports on using geothermal energy sources for hydrogen liquefaction are limited. Jonssson et al. [9] investigated the feasibility of using geothermal energy for hydrogen production and estimated that using geothermal energy could avoid 16% of the work consumption for electrolysis and 2% for liquefaction. Sigurvinssona et al. [10] investigated the use of geothermal heat in high-temperature electrolysis (HTE) process. This HTE process includes heat exchangers and an electrolyser based on solid oxide fuel cell (SOFC) technology working in inverse, producing oxygen and hydrogen instead of consuming them. Using features related to the heat exchangers and the electrolyser, a set of physical parameters will be calculated by using a techno-economic optimization methodology.

Mansilla et al. [11] studied a techno-economic optimization of the upper heat exchanger network in the high temperature electrolysis process for producing hydrogen. Heat obtained by coupling the process either to a high-temperature reactor or to a geothermal source. Ingason et al. [12] investigated the most economical ways of producing hydrogen solely via electrolysis from water, using electricity from hydro and geothermal power. The mixed integer programming model presented here facilitates the search for optimal choices from the 23 potential power plants, 11 of which are based on geothermal sources, and 12 are hydropower stations. Kanoglu et al. [13] investigated the use of geothermal energy for hydrogen liquefaction. In a study, the potential of geothermal resources of the western United States for producing electricity is investigated. This electricity would be used for the production of hydrogen [14].

In this paper, the use of geothermal power for hydrogen production is investigated economically. The electricity produced from a geothermal power plant is used in a water electrolysis process. The cost of producing one kg of hydrogen at various geothermal resource temperatures and mass flow rates are studied considering steam and binary geothermal power cycles.

2. Cost of Hydrogen Production

To compare the hydrogen costs for the hydrogen technologies, a model created by Steinberg and Cheng of Brookhaven National Laboratory in 1989 was used. The model was revised to determine the current and future costs of hydrogen as production technologies improve and become more viable. The model can be broken down into three main parameters that are included in the cost analysis of the hydrogen production: (1) capital costs of the plant, (2) annual operating costs, and (3) return on investment (profit margin). Figure 1 summarizes the resulting hydrogen production costs associated with each of the plants modeled [15]. Steam reformation is currently the cheapest method of hydrogen production and electrolysis powered by the PV powered electrolysis is the costliest. However, the economic analysis of different H_2 production technologies seems to be incomplete without the consideration of environmental cost associated with these processes [16].

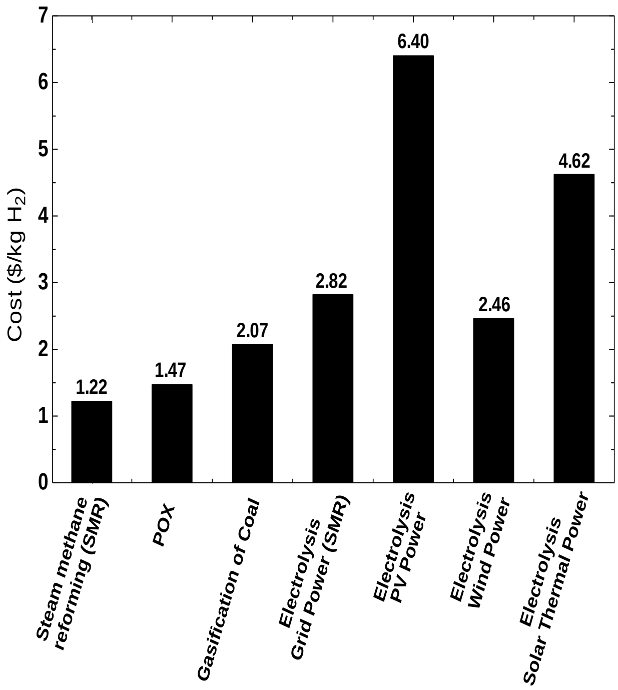

Figure 1. Hydrogen production cost for modeled technologies for 11,870,000 GJ/year production capacity [15]

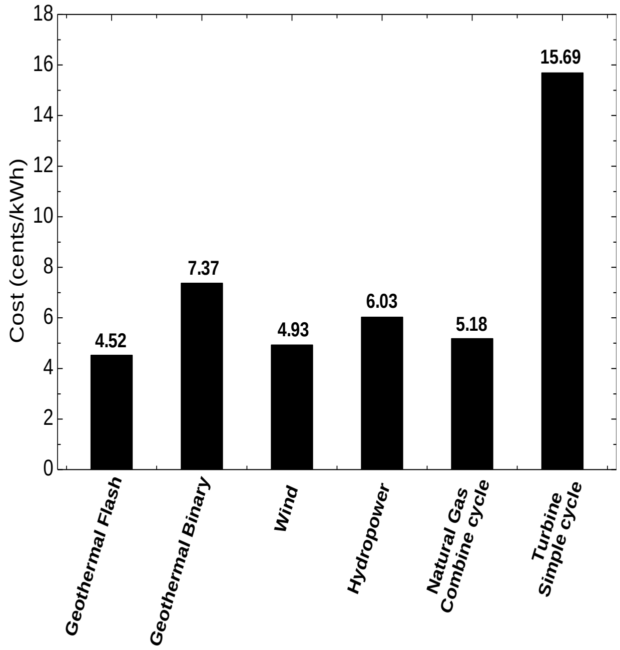

Figure 2. Cost of electricity production for various technologies [17]

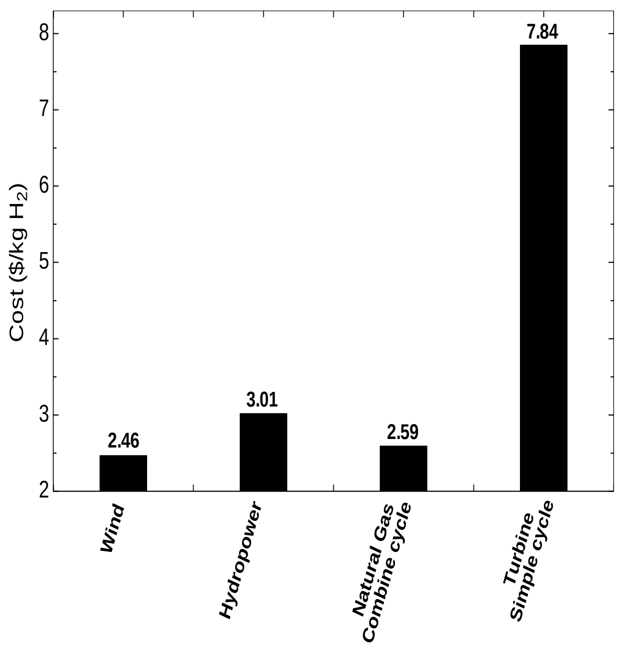

Figure 3. Comparative cost of hydrogen production for various technologies [17]

New geothermal plants are generating electricity from \$0.045/kWh to \$0.074/kWh. Once capital costs for the plant are recovered, the price of power can decrease to below \$0.05/kWh. The price of geothermal energy is within the range of water electricity choices available today when the costs over the lifetime of a plant are considered. Figure 2 presents cost of electricity production for various technologies [17].

In hydrogen production, the most widely used commercial technology is alkaline water electrolysis. The mean electricity energy consumption in the electrolysis of water is about 50 kWh/kg hydrogen.

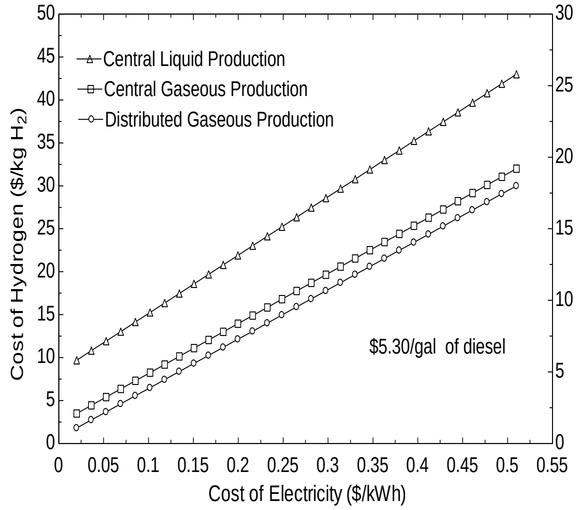

Figure 4. The effect of electricity cost on hydrogen cost [19]

The cost of the electric energy makes large-scale electrolytic production of hydrogen uneconomical compared with the steam-methane reforming method. Work is underway to improve the AWE technology with an advanced alkaline electrolyser that would increase cell efficiency somewhat and reduce the electricity requirement to about 43 kWh/kg [18].

Comparative cost of hydrogen production for various technologies is given in Figure 3. Here, hydrogen is produced by electrolysis method. Wind, hydropower and combined cycle involve much lower costs compared to simple Rankine cycle [17].

When comparing costs of various power producing methods, renewable and non-renewable, it should be noted that renewable technologies provide other system and environmental benefits that are not generally reflected in market prices.

Electricity rates proved to be a major contributor to the overall hydrogen cost. Based on reasonable efficiencies, an electricity cost of slightly less than \$0.10/kWh would be needed to produce and deliver central gaseous hydrogen that is cost-competitive (Figure 4). Cost of hydrogen increases linearly with increasing cost of electricity [19].

3. Cost of Hydrogen Production by Geothermal Energy

Many research and development projects throughout the world are devoted to sustainable hydrogen production processes. Low temperature electrolysis, when consuming electricity produced without greenhouse gas emissions, is a sustainable process, though having limited efficiency. To be sustainable, a hydrogen production process must be carried out without consumption of any raw materials other than water and be driven by forms of energy produced without greenhouse gas emissions.

Low-temperature electrolysis carried out using sustainably produced electricity satisfies these criteria and is currently used to produce hydrogen. However, today, due to high capital costs, it is more expensive in economic terms than the process of producing hydrogen by steam reforming of natural gas; and alternative processes will not be implemented unless they result in lower production costs [20].

When hydrogen is produced by electrolysis, the necessary electricity input can be obtained from a geothermal power plant. The cost of producing electricity from a geothermal power plant depends on many factors. The more significant factors are cycle type (single- or double-flash, binary, flash/binary etc.), resource temperature, mass flow rate of geothermal water, and well cost. These parameters in combination determine, to a large extent, the economic value of a geothermal resource. The other parameters include well spacing, well replacement rate, steam content (quality), non-condensable gas content, plant site, power cycle, plant efficiency, and load factor [21].

In the present study, the cost of producing hydrogen by geothermal power is investigated. The economic model for the cost of geothermal power is based on the study by Bloomster and Knutsen [21]. In this model, two power cycles are considered: binary cycle and steam cycle. The binary cycle uses isobutane as the working fluid, The steam cycle model is based on a double-flash steam plant. The electricity requirement for the electrolysis is taken to be 50 kWh/kg hydrogen.

Figure 5 shows the cost of hydrogen as a function of temperature of geothermal fluid at various flow rates. The cost of hydrogen decreases with increasing temperature. This is expected since the thermal efficiency of a geothermal power plant increases with resource temperature. At lower temperatures small changes in temperature have a larger impact on hydrogen costs, while at the higher temperatures the impact is smaller. The cost is inversely proportional to the flow rate since higher flow rates correspond to larger plant installments. It is well known that as the plant size gets larger the cost of power decreases.

In the economic model of geothermal power cycles, the binary cycle appears more economic than the steam cycle below about 225°C (see Figure 5). Power plants using the steam cycle, however, are closely competitive, running about 10% higher in total power costs at 200°C and 20% higher at 160°C. The breakeven temperature and comparative advantage of either cycle could vary over a wide range depending on the relative costs of the energy supply and power plant, the non-condensable gas content, scaling rates, and other factors.

Figure 6 shows the cost of hydrogen as a function of mass flow rate of geothermal fluid at various temperatures. The cost of hydrogen decreases with increasing flow rate. This is expected since the larger flow rates correspond to larger plant installments and as the plant size gets larger the cost of power decreases. Hydrogen costs are much more sensitive to flow rate at lower temperatures than at higher temperatures because the thermodynamic efficiency declines rapidly with temperature. Well flow rate and temperature are two of the most important resource parameters in the cost relationship. The importance of the well flow rate to power cost is that, for a constant temperature, the power production potential from a well is proportional to flow rate. Therefore, the number of wells and the cost of the energy supply to the power plant are directly related to flow rate.

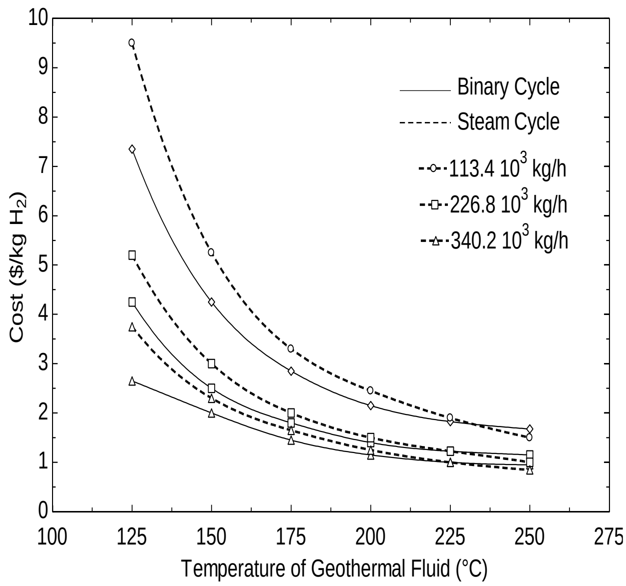

Figure 5. Comparative effect of temperature of geothermal fluid on cost of hydrogen production [21]

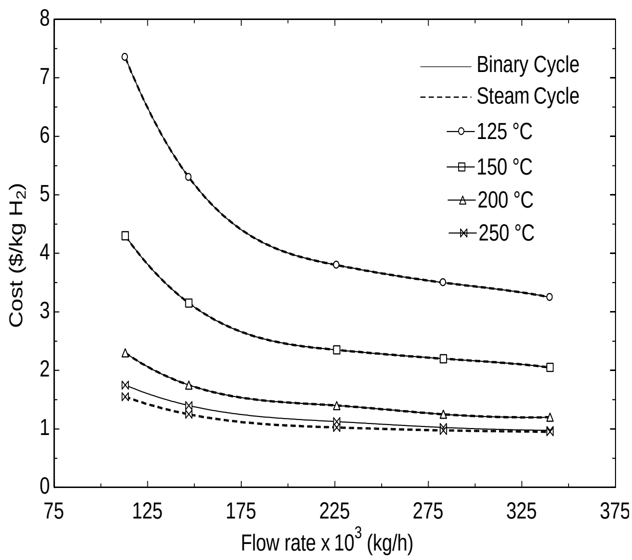

Figure 6. Effect of flow rate on the cost of hydrogen production [21]

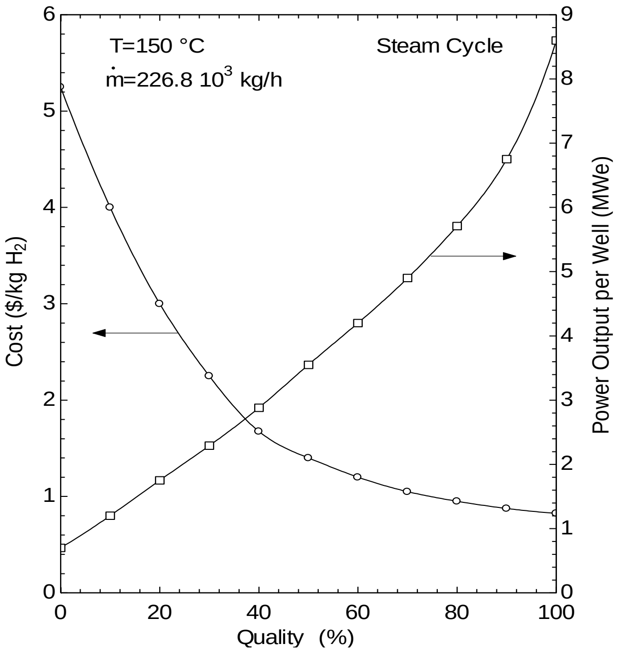

Figure 7. Effect of steam content (quality) on power output and cost of hydrogen production [21]

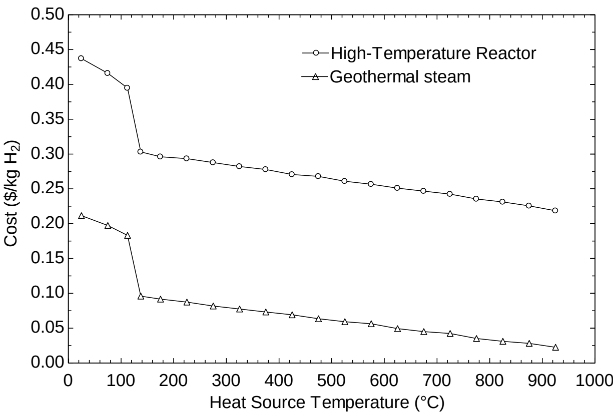

Figure 8. Cost of vaporizing and heating water to the required temperature for the electrolyser [20]

The steam content at the wellhead has a significant effect, like well head temperature, on hydrogen production and power cost (Figure 7). The steam content is expressed as the mass percent of saturated steam in the geothermal fluid at the wellhead. Note that most existing geothermal resources are liquid dominated. The enthalpy of the brine increases rapidly with the steam content. If the temperature and flow rate remain constant, the cost of hydrogen production decreases rapidly with steam content contrary to the power output per well. Steam content and fluid temperature are both related through the common factor, enthalpy.

High temperature electrolysis is an alternative to the conventional electrolysis process. Some of the energy required to split the water is provided as heat instead of electricity, thus reducing the overall energy required and improving process efficiency. Because the conversion efficiency of heat to electricity is low compared to using the heat directly, the energy efficiency can be improved by providing the energy to the system in the form of heat rather than electricity. Thermal energy from a geothermal source is very inexpensive compared to thermal energy from a high temperature cooled reactor (HTR) (Figure 8).

4. Conclusions

Geothermal energy has a significant potential on hydrogen economy where it can contribute sustainable production of hydrogen. In using geothermal energy, the production of hydrogen can be viewed as a carbon free process. The geothermal plant generates the electricity for the electrolysis plant. Once the hydrogen is produced, storage and distribution methods need to be considered. Hydrogen is sometimes liquefied for storage. Geothermal power may be used for hydrogen liquefaction process. Geothermal heat may also be used for precooling hydrogen in an absorption refrigeration system before hydrogen is liquefied. These examples show that geothermal energy can be used in various ways in a sustainable hydrogen economy.

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Investigation of hybrid electric vehicle control systems

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ABSTRACT

Although hybrid vehicles are not widely used, they have an important role in terms of energy saving in the world. Control systems are one of the most important mechanisms in these vehicles for efficiency of energy usage. In this study, it is explained what the control systems of hybrid electric vehicles (HEV) are used and how they are used by review them. It is firstly shown how the internal components of the hybrid vehicle are controlled by the control systems and how the control unit is placed. The control systems are then individually classified among themselves. Control systems that are divided into two groups, which are rule based and optimization based, are collected under these two main headings.

1. Introduction

Nowadays, there are activities in our country about efficiency and saving because of bad environmental conditions, oil dependency and limited energy. Particularly vehicles are one of the most important factors in terms of efficiency and saving of fuel, emission that are environmental effect. One of the solutions for zero emissions is to produce vehicles that use only electrical energy. However, electric vehicles have not been superior to internal combustion motor vehicles in terms of energy capacity. For these reasons, hybrid vehicles have been developed using both electric power and internal combustion engines have started to be used. Hybrid vehicles use an electric motor instead of an internal combustion engine due to the low efficiency of braking in city traffic and in the case of stop-and-go situations. In interurban roads, internal combustion engines are used. Hybrid vehicles may have advantages in terms of fuel consumption and emissions other than internal combustion vehicles, some of which may be smaller than the engine, and may be recovered from freely generated energy. This makes it complicated in hybrid vehicles and it is necessary to control these components which move the vehicle. In order to the well control systems, an appropriate mathematical model has to be created.

In Figure 1, It is shown how to assemble engines, generators, batteries and the power control unit that controls them on the interior of the vehicle in the new generation hybrid systems, which is taken from Toyota's Global Strategy Report data [1].

The working scenario of a hybrid vehicle with control systems is as follows [2]:

- *Start and low speed;* the internal combustion engine does not start. Automobile is only actuated by the electric motor in operation.
- *At normal driving speed;* the internal combustion engine is divided in two sections by the power transmission unit. First part of the power is firstly transferred to the generators for the operation of the engine, and the remaining power for the internal combustion engine is transferred directly to the wheels. This operating principle is checked for maximum efficiency.
- *Acceleration;* In this case, power is provided from the internal combustion engine and electric motor as well as from the battery because of the extra power required.

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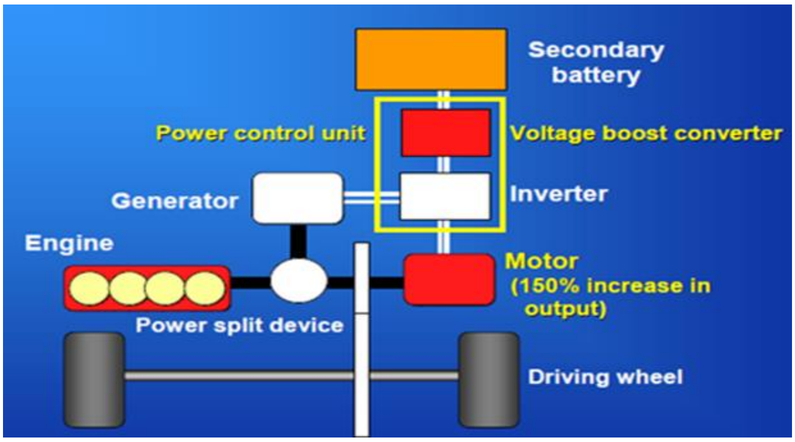

Figure 1. Schematic representation of internal components in the hybrid electric vehicle (block diagram of Toyota Next Generation Hybrid System) [1]

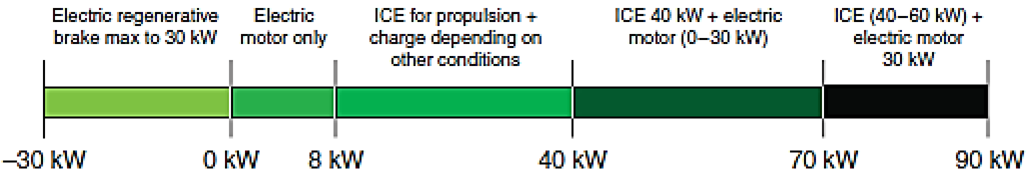

Figure 2. Working principle of hybrid electric vehicle [11]

- *During deceleration and braking*; the kinetic energy obtained when the braking is converted to electric energy for charging the battery.
- *The charge of the battery* is checked for min and max levels. When the battery is approaching the end of charge, the internal combustion engine will drive the generator and allow it to charge.

Figure 2 shows how the hybrid electric vehicle must operate via the control system for an example. If the vehicle demand power is less than 8 kW, only the electric motor is used to drive the vehicle. If the demand power of the vehicle is between 8 and 40 kW, the internal combustion engine empowers the vehicle and depends on the state of charge the battery is charging. If the vehicle demand is between 40 and 70 kW, the internal combustion engine generates a constant 40 kW of power and the electric motor generates additional mechanical power to meet the power requirement. If the vehicle demand is between 70 and 90 kW, the electric motor will draw a maximum of 30 kW and the internal combustion engine generates additional power to meet the power requirement of the vehicle [3, 11].

Figure 3 shows the interconnections and interactions of the internal components in the hybrid vehicle with each other in the control system. Where the electric motor produced by the generator is more than it consumes, the excess electrical power is loaded into the battery. Or if the generator produces less than the electric motor consumed, the battery is charged with electricity and transferred to the motor. The electric power distribution control meets the specified requirements of the signals, the internal combustion engine, the generator and the electric motor according to the given command values. The internal combustion engine controller, the generator controller and the electric motor controller control the internal combustion engine, the generator and the electric motor, respectively, in order to obtain the command values of the electric power distribution control [4].

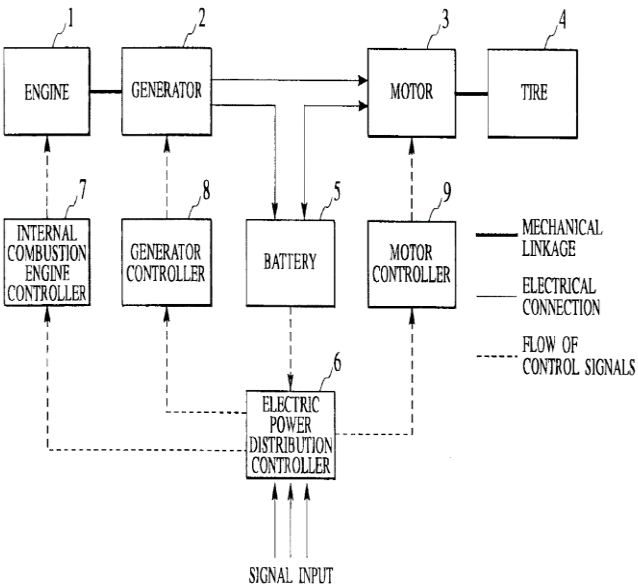

Figure 3. Block diagram showing control system of hybrid vehicles [4]

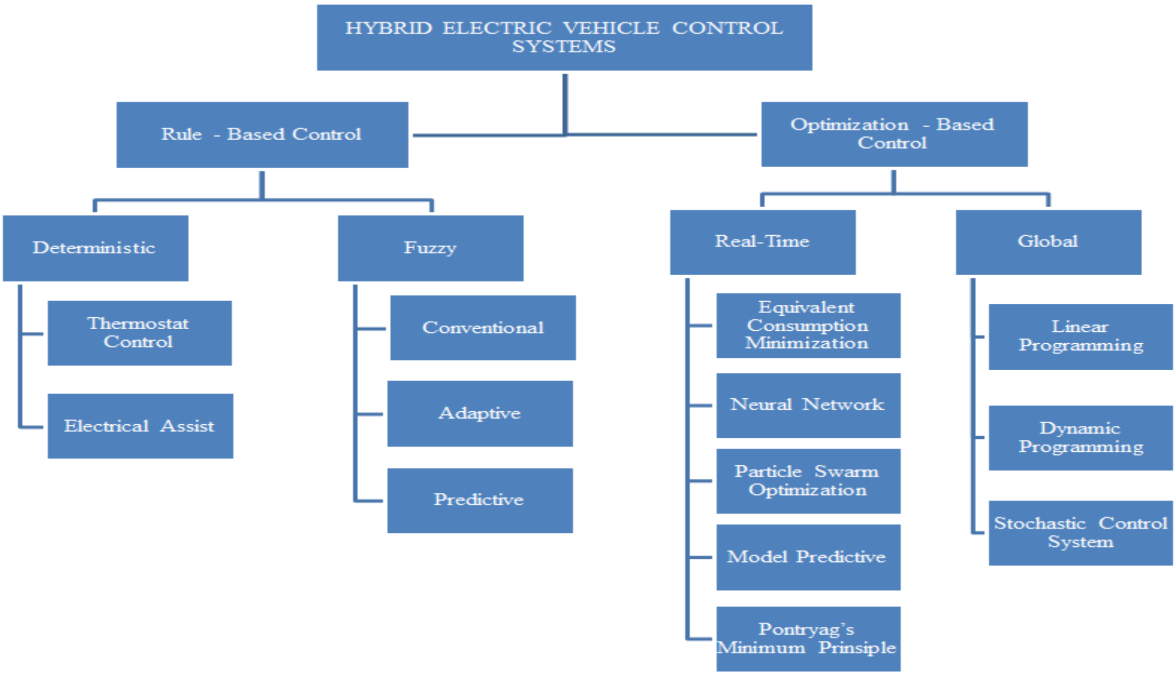

Figure 4. Classification of control systems of hybrid electric vehicles

2. Hybrid Electric vehicle Control Systems

The control systems of hybrid electric vehicles can be classified as shown in Figure 4 [5].

2.1. Rule-Based Control System

This system enables the components in the hybrid vehicle to work most efficiently using rule tables or flow charts. Decisions are made only with instant inputs. The rules used in this control system are as follows [3].

1. Only electric motor is used at low power and speed.
2. Both electric motor and internal combustion engine are used at high power and high speed.
3. In long roads, ie in stable driving conditions, only internal combustion engine is used.
4. An internal combustion engine is used to charge the battery and provide power to the electric motor depending on the charge state in the battery.
5. Maximum regenerative brake is used.
6. The efficiency of the hybrid system is optimized by controlling the power of the electric motor.
   - An electric motor is used to drive the internal combustion engine to higher efficiency zones.
   - If the speed of the electric motor is optimum, the battery is charged.
   - The charge state of the battery is kept at 0.5-0.7 for efficiency and higher battery life.
   - The battery is charged when the demand for the vehicle is low.

The rule-based control system is divided into two subcategories.

2.1.1 Deterministic Rule-Based Control System

Fuel economy and emission data, internal combustion engine operating maps, power flow in powertrain, and people's driving experience can help in the design of deterministic rules [6].

M. Zaher and S. Cetinkunt [7] developed a rule-based control system for reliable control and divided the subcategories of the deterministic control system into a working cycle.

Thermostat control system: In this system, two charging states are determined by looking at the efficiency map of the battery which will be opened and closed according to the motor charging state. These two values are designed to cover the most efficient region in the operation of the battery. According to this system, if the battery reaches low level, the internal combustion engine starts to work and the battery continues until it is charged. Then the internal combustion engine stops and remains the same until the battery is discharged. This cycle repeats itself [8].

Electrical assist control system: The internal combustion engine providing the power source and the operation of the electric motor provides the additional required power. Because the internal combustion engine performs charging, the battery charge status is preserved in all operating modes [10].

2.1.2 Fuzzy Rule-Based Control System

The fuzzy logic system is a form of reasoning developed from the fuzzy set theory. This system is used in decision making by coding in the rule base. One of the advantages of this system is that it can be adjusted at any time. This makes it easier to control the hybrid vehicle. Because it is nonlinear, it may be more suitable for complex structures such as powertrains [9].

Conventional fuzzy rule-based control system: This system uses optimum fuel usage and fuzzy efficiency modes to control the operation of the transmission organs. The fuzzy efficiency mode inputs as input the charge state of the battery and the desired internal combustion engine torque. Accordingly, the operating point of the internal combustion engine is set. The power required by the electric motor is equal to the difference between the required total power and the incoming power from the internal combustion engine. The fuzzy-based control system diagram is shown in Figure 5 [3]. This system calculates the power that comes from the vehicle speed, demand power and charge state of the battery. The calculated power is sent to the fuzzy-based controller to calculate how much power the electric motor should produce and how much power the internal combustion engine must produce to meet the total power requirement. For example, the fuzzy logic calculated motor power is determined as 7 kW for an internal combustion engine to meet a power of 25 kW in a 18 kW regulated vehicle [11].

Adaptive fuzzy rule-based control system: This system can optimize both fuel efficiency and emissions at the same time. But emissions and economy are contradictory. Therefore, a completely optimal solution cannot be obtained. Weighted total approach optimization of conflicting goals is used to achieve an optimal solution. Relative weights are assigned to each parameter according to their importance in different driving environments. This control system can control any of the targets by changing the values of the weights. In addition, there is a decline in vehicle emissions, ignoring the fuel economy [10].

Predictive fuzzy rule-based control system: This system can be solved when there is heavy traffic or using the global positioning system (GPS). Due to its robustness and speed, it is recommended to use it for non-linear and indeterminate systems. In the case of Salmasi2, it is a wise decision to recharge the battery to use a motorized vehicle if you are on a highway with heavy traffic in the future. This means that non-optimal solutions of real-time algorithms can be shifted to near optimal solutions by predictive control. For this system, a fuzzy logic predictor controller was developed at Ohio State University. It adapts the speed estimates that occur due to the traffic situation in the future with the current controller parameters. The input of this system is the change in vehicle speeds, the speed condition of the vehicle in the front zone, and the points determined along the route in the navigation system. The output is a GPS signal that tells the main controller to charge or use the batteries according to future vehicle conditions. For example, if navigation gives downhill and faster traffic warnings, the estimated controller tells you not to use the battery [12].

2.2. Optimization-Based Control System

The objective in optimization-based control system is to minimize the cost. In a hybrid electric vehicle, the cost function depends on emissions, fuel consumption and engine torques. Optimization based control system is examined under two main headings as real time optimization and global optimization.

2.2.1 Global Optimization-Based Control System

For the global optimization system, the battery charge status, driving conditions and response are also required at the same time. This system is more difficult to implement than real-time optimization due to account complexity. Delprat et al. assume that the fuel consumption and emissions are reduced, a global optimization algorithm has been developed [13].

Linear programming: This system is an important system in terms of fuel economy optimization. Fuel economy optimization generally used in serial hybrid vehicles. This problem can be solved by linear programming of the global optimal-based control system. Tate et al. [14] proposed to solve the nonlinear optimization problem of the hybrid vehicle by linear programming method to find the fuel efficiency by controlling the gear ratio and torque in the transmission organs. Pisu et al. [15] have designed a balanced and robust controller that uses linear matrix inequalities for fuel consumption, that is, for the powertrain of hybrid electric vehicles to optimize the economy.

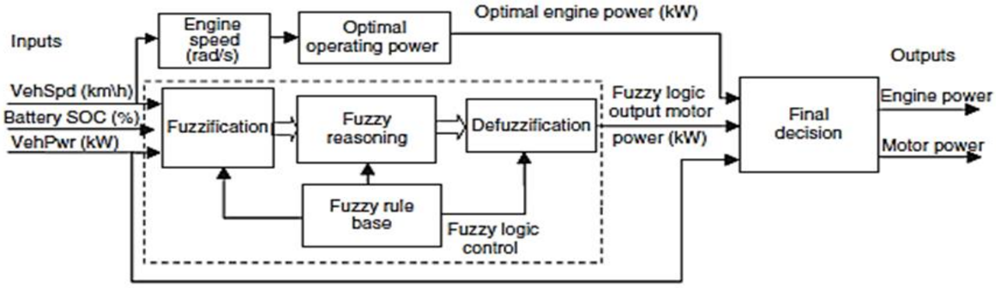

Figure 5. Fuzzy-based control system diagram [11]

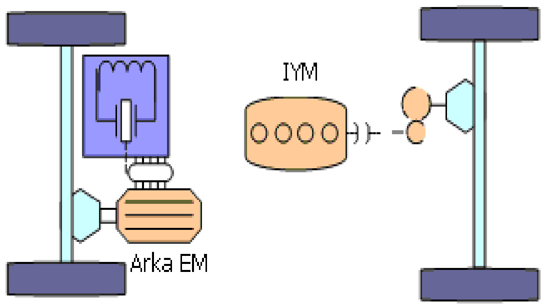

Figure 6. Vehicle model for dynamic programming [27]

Dynamic programming: This system was used by Richard Bellman16 in 1950, and the parts of the optimal system are also based on optimal. According to this principle, if the way between x(0) and x(p) is the optimal path, then the sub-ways between x(k) and x(k + 1) have to optimum (0<k<p). Dynamic programming is both a mathematical optimization method and a computer programming method. It can be used in linear or non-linear systems. At the same time, this method is preferred because it is difficult for analytical solution to have a large number of components in hybrid vehicles. For dynamic programming, the vehicle model shown in the figure 6.27 is used. The vehicle can be driven by an electric motor at the rear, while the front motor is driven by an internal combustion engine.

Stochastic control system: This control system is formulated as a stochastic dynamic optimization problem on the infinite horizon. The power demand from the drive is modeled as a random Markov operation. Markov operation predicts future power demands by producing probability distribution. The stochastic control system can solve ambiguous optimization problems using stochastic dynamic programming. This stochastic dynamic programming algorithm is found to be better than the deterministic control system [10].

2.2.2 Real Time Optimization-Based Control System

As mentioned in the previous section, global optimization does not control the cost function of the parameters to an instant optimization and changes in charge state. Real-time optimization is used to control the battery charge status [10].

Johnson et al. [18] have designed controllers that estimate energy consumption and emissions for each identified point. They used efficiency and emission optimization in a parallel hybrid electric vehicle with a real-time control system.

Equivalent consumption minimization: Paganelli et al. [19] addressed the concept of equivalent fuel consumption. Equivalent fuel consumption minimization does not require prior knowledge of driving and is implemented in real time. It provides a solution by calculating the amount of fuel equivalent as a function of online measurement. The total fuel consumption in the hybrid electric vehicle is the sum of the equivalent fuel consumption values taken from the internal combustion engine and the electric motor. Because of this, both the energy used in the battery and the fuel consumption of the internal combustion engine are given together. The equivalent fuel consumption minimization control system does not use future forecasts and can compensate for the uncertainties in dynamic programming.

Neural network control system: McCulloch and Pitts first designed a neural network in 1943 under this system. An artificial neural network is a parallel computation method which is composed of many connected processes. This method uses the principle of function approach. Neurons are used in the artificial neural network, and the weights of these neuron inputs and the deviation function give rise to the neuron output. The main purpose of this system is to calculate the output of all nerve cells. The adaptation of the neural network and its fit to the look-up table makes it better than the rule-based control system [20].

Arsie et al. [21] modeled a dynamic system with the components of the vehicle. According to this system, the vehicle load estimation is realized by optimizing the control system used for the optimum performance of the vehicle by using the neural network system.

Particle swarm optimization control system: This system was developed in 1995 by Eberhart and Kennedy [22]. This technique is used for continuous nonlinear processes and is inspired by birds in the nature. It is a recursive optimization using particles. These particles wander around a search field. All the herds are directed to the best position within this area and are repeated in this way. The operating system in this way can appropriately determine the energy flow direction and quantity in hybrid electric vehicles. Therefore, it works with high efficiency in powertrain and reduces fuel consumption.

Desai and Williamson [23] optimized drivelines and control systems using particle cluster optimization to reduce fuel consumption and emissions in their work.

Model predictive control system: This control system is a good method for dynamic models. The model prediction control system ensures that the current time is optimized using the future time. At the same time, the control system can take precautions by foreseeing future events [10].

West et al. [24] used this method to increase the life of the battery, thereby reducing the toxic emissions while increasing the range that the vehicle can go through. It starts oscillations in hybrid electric vehicles.

Pontryagin's minimum princible: This principle provides the necessary conditions for the optimization of the problem rather than the direct calculation of the control process [25].

In 1956, the Russian mathematician was formulated by Lev Semenovich. It is an example of the Euler-Lagrange equation. This system provides only the necessary conditions with the Hamilton-Jacobi-Bellman equation for optimization.

Stockar et al. [26] proposed a model-based control system to reduce emissions the most. This control system has been transformed from the global optimization to the local optimization with the minimum principle of Pontryagin to ensure optimal energy use for hybrid vehicles.

Table 1 compares the control systems used in hybrid electric vehicles to understand the advantages and disadvantages of the control methods [10]. *S. Comp, C. Time and S. Type* present structural complexity, computation time and type of solution, respectively. Requirement of prior knowledge is also given in this table.

3. Conclusion

In this study, the components of the hybrid vehicle, the internal combustion engine, the electric motor, the generator, the battery and control systems that optimize the performance of the hybrid electric vehicle in terms of fuel efficiency, emissions and cost are presented. The most appropriate power flow control schemes implemented by controllers in series, parallel and series-parallel systems are shown. In order to find the most suitable method among the control systems mentioned in this study. The lower structural complexity, the shorter calculation time and the global solution type are suggested. When we look at these situations, it is more appropriate to use the fuzzy method and model predictive control systems. However, it is still unclear which one is most appropriate, whether or not there is a need for preliminary information.

Table 1. Comparison of control systems used in hybrid electric vehicles

Control System	S. Comp.	C. Time	S. Type	Prior knowledge
Fuzzy logic	No	Small	Global	Yes
Particle swarm optimization	No	More	Global	No
Energy consumption minimization strategy	Yes	Small	Local	No
Pontryagin's Minimum principle	No	Small	Local	Yes
Dynamic Programming	Yes	More	Global	Yes
Model predictive	No	Small	Global	No
Stochastik control	Yes	More	Global	No
Neural network	Yes	Small	Global	Yes

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Exterior surface insulated panel radiator and energy efficiency analysis

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ABSTRACT

The economic use of nonrenewable energy has become more important in recent years. One of the works done for this purpose is thermal insulation. Thermal insulation is the process of increasing the efficient use of thermal energy. Panel radiator is adjacent to the building wall and direct heat loss occurs from the outer surface to the wall facing surface of the panel radiator. This research was done to minimize the heat loss from the outer surface of the panel radiator. Firstly, the external heat loss from the panel radiator is calculated according to the uninsulated radiator. Then heat loss calculation was made for the panel radiator covered with polyurethane outer insulation material. In calculations with independent variables, the isolated panel radiator was found to provide 122.18 joules of energy per second into the room. This result shows that the outer surface insulated panel radiator provides significant energy efficiency.

1. Introduction

Panel radiator heating system device, transfers the thermal energy in the water to the air. This heat transfer takes place with convection of 80% and radiation of 20%. [1]

Water is heated in the heating boiler and sent to the radiator via connection pipes. The heat is transferred from the radiator and the cooled water returns to the heating boiler. The cold water is reheated in the heating boiler and sent to the radiators. The desired environment is heated with this cycle.

Heat transfer takes place from each surface of the panel radiator. Panel radiator exterior surface adjoins wall and so there is heat loss from the outer surface of the panel radiator. [2] The outer surface of the radiator is covered with polyurethane insulation material, heat loss is reduced and thermal efficiency is ensured.

2. Material and Methods

2.1. Method of analysis

Heat transfer with convection is the continuous displacement of the heated air on the radiator surface with the cold air and heat transfer with conduction is heat transfer from the building to the outside (Figure 3.).

Heat transfer is assumed to be continuous, laminate, two - dimensional, the air assumed Newton type to achieve easier results in analysis. Heat transfer with radiation from the radiator surface can be neglected, because it is a small value.

Figure 1 shows the typical speed and temperature profile for natural convection flow on vertical plate. The velocity of the fluid air in the environment is zero at the outer edge of the velocity boundary layer as well as at the surface of the plate. The radiator temperature drops until it is equal to the ambient air temperature. [3]

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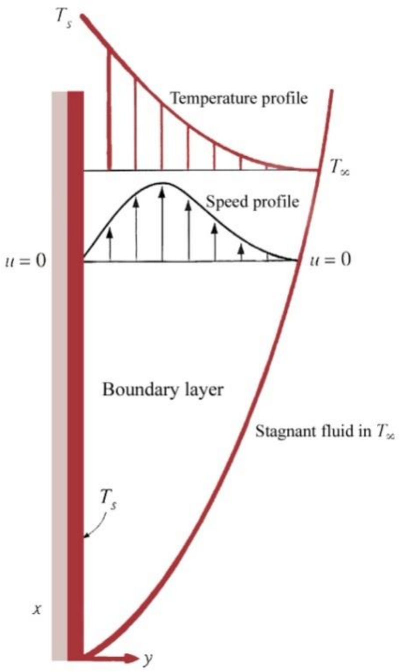

Figure 1. Typical Speed and Temperature Profiles for Natural Convection Flow on Vertical Plate [3]

For the analysis, the radiator surface temperature, the temperature of the fluid air , the temperature of the outside environment, properties of polyurethane insulation material and dimensions of the radiator are determined. The dimensions of the radiator are also shown in Figure 2.

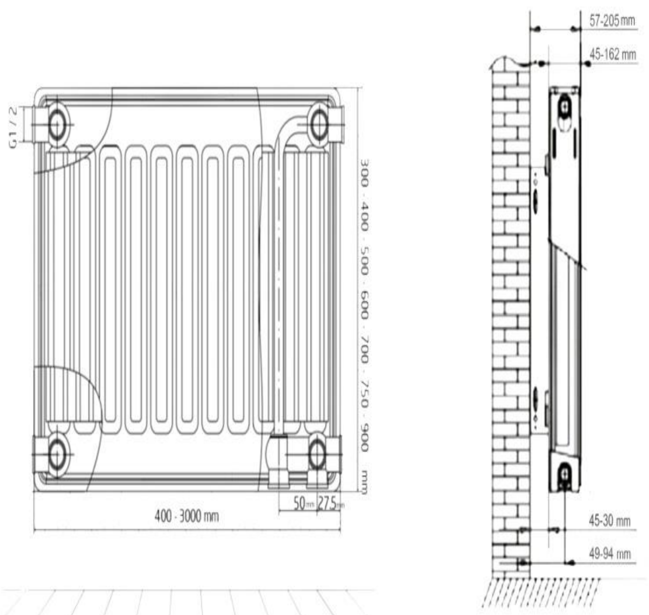

Figure 2. Dimensions of the Radiator [4]

2.2. Analysis

H=1m L=0.6m T_s=70˚C T_∞=10˚C

T_2= -10˚C P_{atm}=101.3 kPa g=9.807 m/s^2

k=0.02662 W/mK

$$T_f = (T_s + T_\infty)/2 \quad (1)$$

$$B = 1/T_f \quad (2)$$

$$Gr = \frac{gB(Ts - T\infty)L^3}{v^2} \quad (3)$$

$$Ra = Gr \times Pr \quad (4)$$

$$Nu = \left(\mathbf{0.825} + \frac{0.387Ra^{1/6}}{(1+(0.492/Pr)^{9/16})^{8/27}}\right)^2 \quad (5)$$

$$h = (k/L)Nu \quad (6)$$

$$A_s = HxL \quad (7)$$

$$Q = hA_S(T_s - T_\infty) \quad (8)$$

[3]

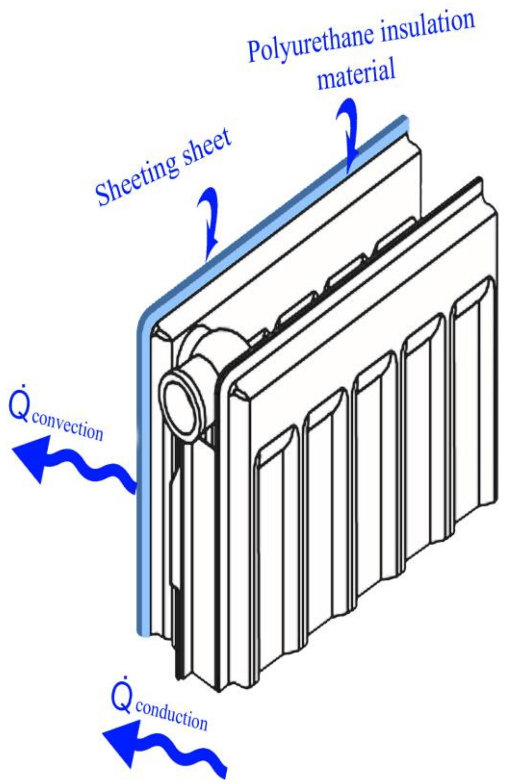

Figure 3. Insulated Construction of Panel Radiator

In Figure 3 shows the construction of the insulated panel radiator [5] and direction of heat transfer. Outer surface of panel radiator covered with polyurethane insulation material and insulation material covered with protective plate. Equations 1, 2, 3, 4, 5, 6, 7 and 8 are solved with fixed H, L ,T_s, T_∞, T_2, P_{atm} , g, k values. Insulated and non-insulated panel radiator calculations are made.

3. Conclusions

As a result of calculations with independent variables; 197.78 j/s of energy was transferred from the uninsulated panel radiator to the building wall and 75.6 j/s of energy was transferred from the insulated panel radiator to the building wall. The insulated panel radiator provides energy gain of 197.78 - 75.6 = 122.18 joules per second. With this result it is clear that the insulated panel radiator has improved its energy efficiency with polyurethane thermal insulation material.

When it is thought that the use of an insulated panel radiator in every building, the gain of nonrenewable energy around the world will be very large.

Nomenclature

H	:	Width of panel radiator
T_f	:	Film temperature
Pr	:	Prandtl number
B	:	Volumetric expansion coefficient
Ra	:	Number of rayleigh
Nu	:	Nusselt number
h	:	Heat transfer coefficient
P_{atm}	:	Atmospheric pressure
T_∞	:	Indoor temperature
Q	:	Transfer energy
L	:	Height of panel radiator
k	:	Thermal conductivity coefficient of polyurethane insulation material
v	:	Kinematic viscosity
T_s	:	Surface temperature of panel radiator
A_s	:	Surface area of panel radiator
Gr	:	Grashof number
T_2	:	Outdoor temperature
g	:	Acceleration of gravity

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Material Requirement Planning in a Briquette Factory

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ABSTRACT

In this study, material requirement planning was carried out for a company that produces briquette, uses several main products and hundreds of raw materials and semi-finished products. The fact that material requirements planning is not applied at the moment is causing the production of customer complaints, causing disturbances and confusion in stocks. This situation, which resulted in poor performance on behalf of the company, made material requirement planning inevitable. For the study, the company's current situation was analyzed first. Using the data obtained afterwards, a regular MRP system was established with Akınsoft Wolvox ERP program and the resulting results were analyzed. The problems encountered are solved by the Akınsoft Wolvox ERP program, in which MRP production is made more efficient and faster than the normal structure, customer satisfaction is increased and inventory confusion is prevented.

1. Introduction

Factors such as sustainability of production, management of orders, efficient use of time, equipment and financing are among the important factors of the companies. Companies have been competing in the marketing conditions on the market, causing the products to adopt the production system according to the usage requirement and the customer's order.

For this reason, for the product produced; material properties such as weight, shape, type, intermixing must be taken into consideration, although certain areas are used for storage of the required materials. The provision of such needs was made possible by the introduction of the first MRP (Material Requirements Planning) software in the 1960s with the spread of computers in businesses [1]. Since the 1990s, the calculation of material requirements with the help of softwares has brought to the service of the companies with today's advanced software with Enterprise Resource Planning (ERP) software [2]. MRP application is the most basic application used by enterprises producing goods or services. MRP is a system that gives answers to questions such as when a product is produced, how much raw material is needed, and when is the right time to ensure continuity in business. However, each company has its own unique software options, the need to change the operating system factors such as MRP is done in a firm. In this study, we tried to determine the problems and determine the needs of the briquette product in order to prevent the problems in the material requirement planning and to analyze the current situation. The data obtained in the direction of the determined needs were processed into the computer program and the material requirement planning was done. In this context, it is aimed that the production system is specific in terms of employees and managers.

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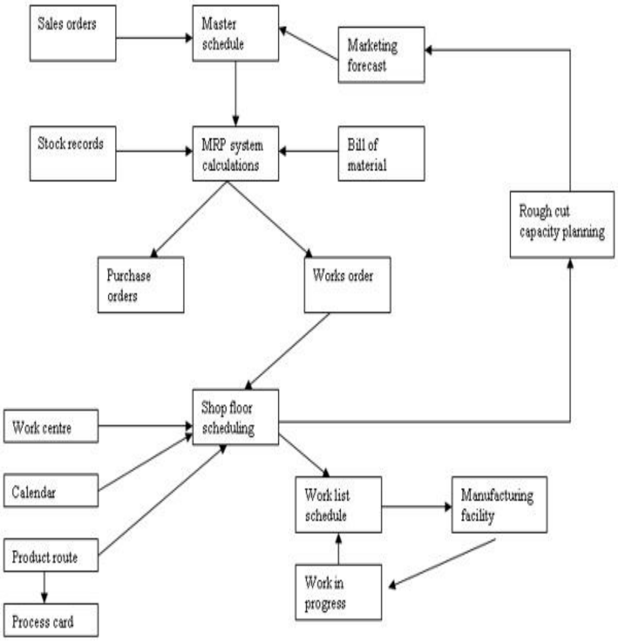


Figure1. MRP System Structure [3]

As shown in Figure 1, MRP softwares consist of many modules that are systematically linked to each other and actively generated. All of the modules use a common database. In our operation, we first examined the existing production system, analyzed the operations that need to be done, and then arranged the system on the products so that the products and employees were made compatible with the system.

In the following sections of the study, firstly literature will be included and the application process will be explained step by step under the heading of material and method. In the material and method section, the problems that can be encountered in MRP software and explanations of solutions are given. In the final part of the study, the positive results obtained by the establishment of the MRP system in the enterprise are included and the forecasts for future production are stated.

2. Literature Review

In 2006, Bayraktar and Efe studied Enterprise Resource Planning software in their work. In the study, the critical factors related to the benefits and the selection process that the ERP system can provide, which can guide the managers who are considering adapting the ERP system to the institution, are emphasized. Turkey element in the current environment, and arranged in accordance with the foreign literature was brought to the attention of decision makers [4].

Çağlıyan explored the basic literature information about ERP in 2012 and explored the effect of the software on the operating performance of the software used by the site using ERP software and by examining the state before and after application of this software. It is seen that the ERP software used as a result of the reviews and evaluations made has significant effects on the performance criteria of the operator [5].

Sudhaman and Thangavel used their Data Envelopment Analysis Fixed Income Scale (DEA CRS) model in 2015 to analyze the efficiency of ERP projects based on quality measures (defect counts) and to identify the most efficient ERP projects. Such projects can serve as potential role models, and the quality processes of these projects can be adopted by future ERP projects that will lead to successful implementation. Findings are both practical and the results are discussed for research and they have suggested the possible areas for future research [6].

In the study they conducted in 2016, Verma and Kumar considered the control system as two prospectively. The first is the interactive control system and the second is the diagnostic control system. These two control systems support the implementation of ERP. The interactive control system supports organizational change and increases employee motivation for ERP implementation while monitoring the results of the diagnostic control system. Based on the existing literature review, they investigated the role of the management control system (MCS) in implementing ERP projects in organizations that can improve organizational performance [7].

3. Materials and Methods

The main work of the study was carried out in an operation which is briquette. In addition to producing briquettes in all sizes, ponza stone, asmolin, key paving stone, pavement and refuge. The company has a drying area of about 1000 m2 and has an area of 2500 m2 in total together with the areas where the materials are placed [8]. Akınsoft Wolvox ERP program was used during the establishment phase of the MRP system after the analysis of the current situation in the operation. Program modules: Current, Current 2, Cashier, Inventory, Inventory 2, Invoice, Check-Bills, Waybill, Bid, Order, Exchange Tracking, Foreign Exchange Depot, Location, Bank, Cardotex (Barcode printing) Tracking, Installment Tracking, Serial Billing, Service, Production, Bonus System, Tube-Water Tracking, MRPII, CRM, Chain Marketing modules.

3.1. Problems Faced During Operation of MRP System

Among the main problems that can be encountered in MRP activities are the inability of users to use new systems, the inefficiency of staff to effectively use the program, the inconveniences that may arise in the software system, the lack of production and software on the same platform, user-inadequate knowledge of the field, and the weakness of communication among the staff. In order to solve the problems arising from these reasons, the MRP system should be transferred.

The foresight in this system should be taken into consideration when facilitating the responsibilities of all the employees working in the company and by explaining the desired qualities more easily. Characteristics such as production system of companies, products produced, characteristics of employees, raw materials used in production, production processes, customer supply systems, customer profiles are different from each other. Therefore, the problems and constraints of each company are completely different from each other. It is extremely important that the ERP software used for this reason can be addressed to the sub-units within each company and company, and that the scope is broad.

The ERP software used in the company must be available to the user in a comfortable manner. Careful attention has been paid to the selection of programs in the study. The limitations in the system of the ERP software used can be changed by the user and this change can be monitored by the authorized user. For this reason, the arrangements and the process time of the production process can be done in a timely manner, and the firm can effectively be assigned under its own structure while creating the task distribution without need of the software company.

A brief training on the ERP software has been given to the staff who relates the program because of the mistakes the user may make. In order to avoid any mistakes that may occur, the trainings given should be regular and the system should be fully adopted by the employees.

3.2. Performing Definitions in the Software Program

In order for the operator to operate more safely and regularly, company information and briquette production flow must be transferred to the computer. It is necessary to create the company's record first when starting to apply. After defining our company, we have to define as stocks such as all main materials, materials to be produced from stock definitions so that we can do operations such as making production, getting products, selling products. The unit definitions of the raw materials to be used should not be forgotten. Unit definitions will benefit us in the field of accounting in transactions such as buying and selling raw materials. The storage area of the raw materials should be determined by adding to the different storage system in order to stock the raw materials to be used. Authorization will only be made for authorized persons to access the warehouse. In this way, the flow of products in the company will be monitored using different warehouses for raw materials and products.

After the current currency definitions have been made, the currencies we have defined will display the current TL conversion. At this stage, we can also incorporate the information of the banks we work with in the system. After this process, we will have to create a current list of products for shopping. Entering your account information such as account information, photos, special discount application, etc. to the system in an up-to-date manner will facilitate us in product marketing. A sample screenshot of the current definitions is shown in Figure 2.

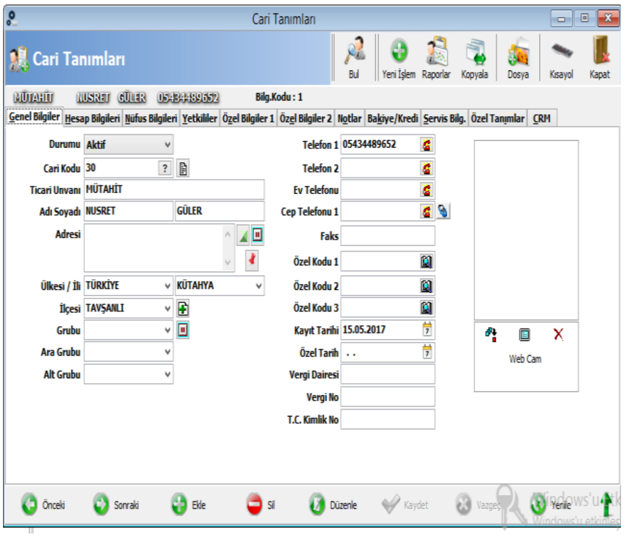


Figure2. Sample screenshot for current definitions

3.3. Production Process Phase

At this stage, the working periods of the machines are primarily determined. Calculations were made to calculate the amount of electricity consumed by the machines and to operate the machines in the most efficient and safe way. Official holidays, festivals are written in program and official holidays are worked for, automatic payment of overtime rates is provided, or the production schedule and order schedule are adjusted accordingly and warned before the holiday on the desired day. For the production of the briquette product, information such as the raw material requirement and the timing is recorded. In the same way, the break times of employees are determined and production planning can be provided in a more systematic way. As a result of the raw materials that make up the product, the product is in the system as a single product in which all the processes are performed. This new product can be used for purchase-sale operations without production. Following the quality reports, the quality of the new product was followed and customer satisfaction was increased in this way. Figure 3 shows a screenshot of the briquetting product tree created by entering related information in the software program. It is necessary to carry out the steps to produce one briquette to be clearly understood.

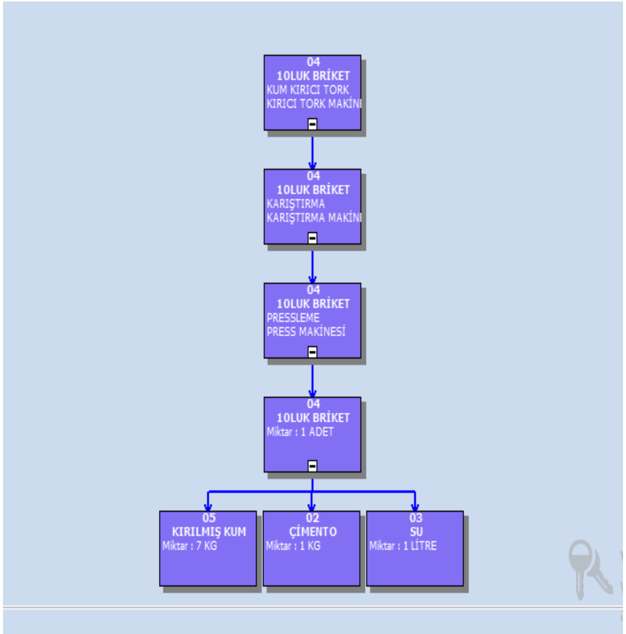


Figure 3. Product tree created in the software program for briquette production

3.4. Purchase / Sales Stage

We will use sand, cement, water stocks to purchase inventory added to inventory. The products we purchased are automatically added to our depot because the invoice is cut off. We registered DEPO1 because we registered the products we purchased as DEPO1.

The current order can be selected from the current list in order to make a sale. We will buy what we buy as stock and as stock amount, and order is taken after this. Figure 4 shows a screenshot of the warehouse movement report. A current list of orders received was created so that the sales process of the product can be realized as clearly understood.

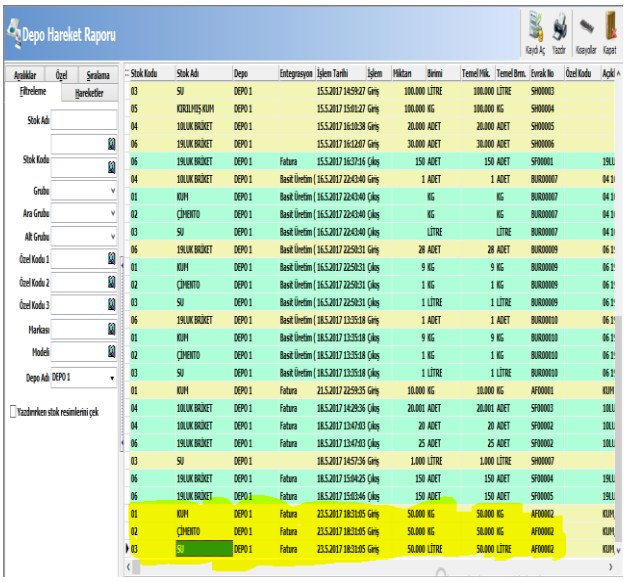
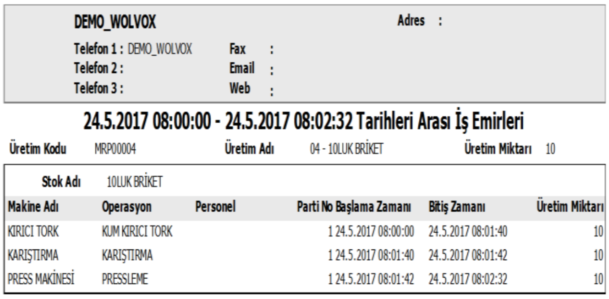


Figure 4. Operator's warehouse movement report

3.5. The Process of Creating Work Orders

In order to make a new production, we need to be able to determine the structure of the product we will produce first. After setting the stock, we need to use the recipe list where the materials, machines, and personnel to be used in production are located. After selecting the appropriate prescription, the amount of production is determined. After the unit cost is calculated, the production status information should be entered. Figure 5 shows the work order screen of the program to produce 10 pieces of 10 briquettes.



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24.5.2017 08:00:00 - 24.5.2017 08:02:32 Tarihleri Arası İş Emirleri

Üretim Kodu MRP00004 Üretim Adı 04 - 10LUK BRİKET Üretim Miktarı 10

Stok Adı 10LUK BRİKET

Makine Adı	Operasyon	Personel	Parti No	Başlama Zamanı	Bitiş Zamanı	Üretim Miktarı
KIRICI TORK	KUM KIRICI TORK		1	24.5.2017 08:00:00	24.5.2017 08:01:40	10
KARIŞTIRMA	KARIŞTIRMA		1	24.5.2017 08:01:40	24.5.2017 08:01:42	10
PRESS MAKİNESİ	PRESSLEME		1	24.5.2017 08:01:42	24.5.2017 08:02:32	10

Figure 5. 10-inch briquette production work order screen display

4. Conclusions

In today's marketing environment, market share, high performances can be achieved by delivering the products and services that the enterprises produce in time, minimum cost, optimum order quantity and best service condition and in the most appropriate time period. In this case, companies should concentrate on the production chain in terms of product supply, production stage and after-sales service, and products should be carried out in a collective manner. By using the produced products in a systematic and timely manner in competitive marketing conditions, the planning and processing stages of the products are provided as advantages in the competitive system. Therefore, the use of MRP (Material Requirements Planning) software gains importance in terms of the selected company when performance of value chain activities is increased. The software that will be used to make the system profitable for the company needs to meet the needs of the company. The results of the studies related to the company using MRP (Material Requirements Planning) software are as follows.

i. The company that produces briquettes produced the products produced until 2017 with complex methods.

ii. The manual complex method slows down the production steps and reduces the efficiency of the machines used.

iii. After the installation of MRP software; ordering of materials and approval period, knowing the amount of material in the shipment and working time of the machines.

iv. With the software installed in the production plan, significant gains have been achieved in examining stock data, material ordering, route operations and production planning, and employee vacation times.

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