ICON TECH SURVEYS

International
ICONTECH SYMPOSIUM
on Innovative Surveys in
Positive Sciences
May 2, 2020
Bursa, Turkey

PROCEEDINGS

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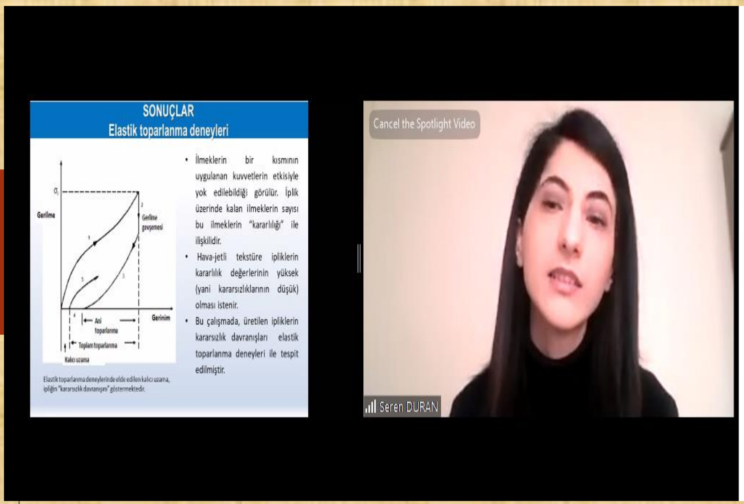
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Elastik toparlanma deneyleri
İlmeklerin bir kısmının uygulanan kuvvetlerin etkisiyle yok edilebildiği görülür. İplik üzerinde kalan ilmeklerin sayısı bu ilmeklerin "kararlılığı" ile ilişkilidir.
Hava-jetli tekstüre ipliklerin kararlılık değerlerinin yüksek (yani kararsızlıklarının düşük) olması istenir.
Bu çalışmada, üretilen ipliklerin kararsızlık davranışları elastik toparlanma deneyleri ile tespit edilmiştir.
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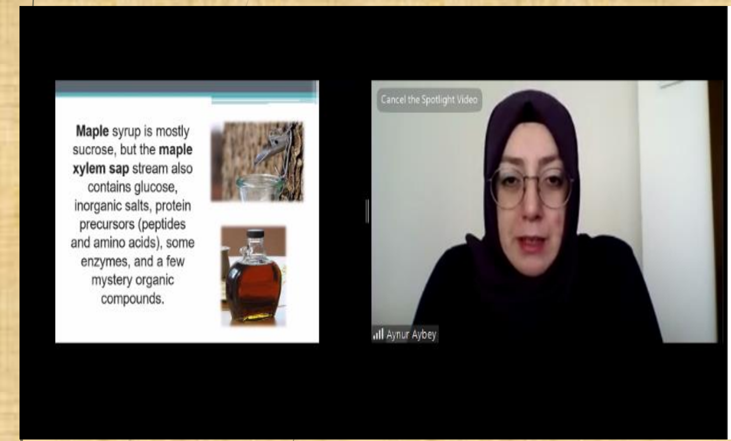
Maple syrup is mostly sucrose, but the maple xylem sap stream also contains glucose, inorganic salts, protein precursors (peptides and amino acids), some enzymes, and a few mystery organic compounds.
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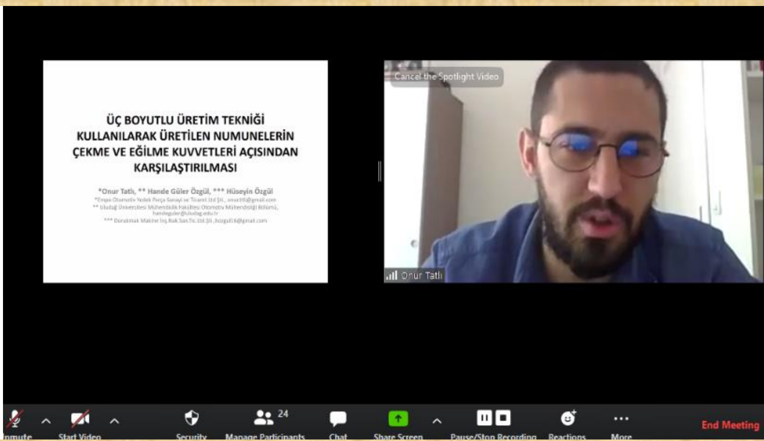
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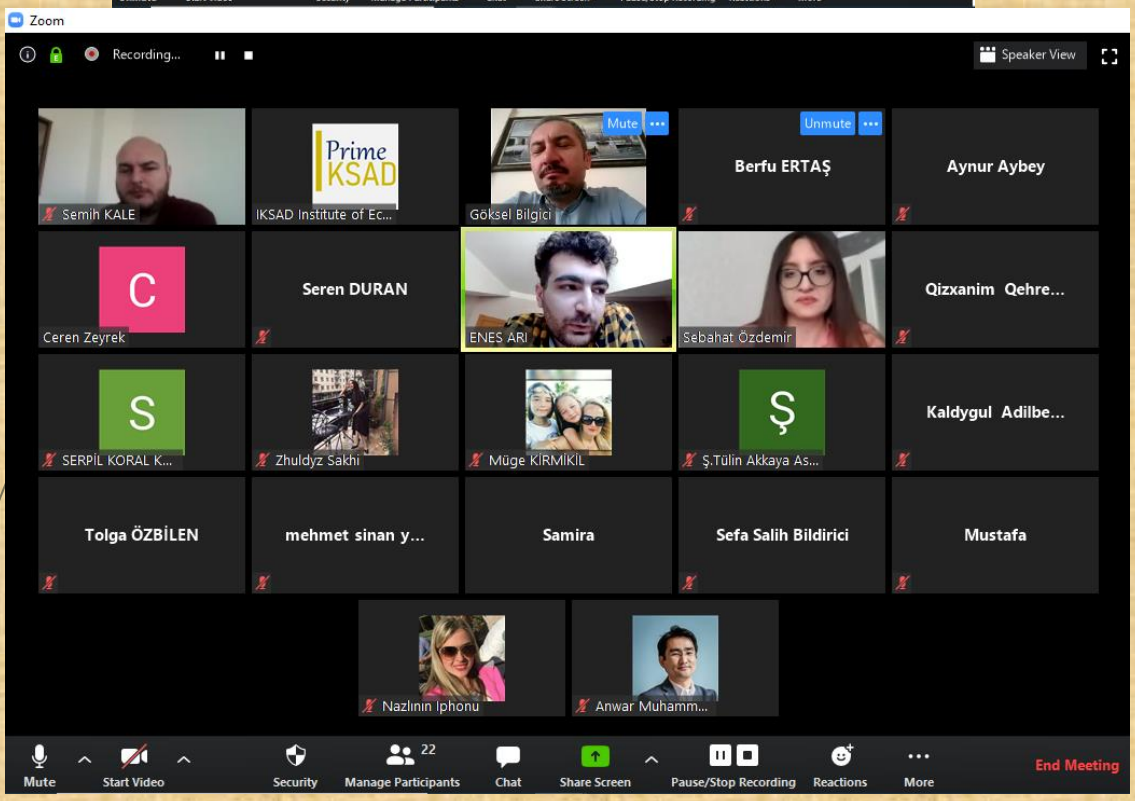
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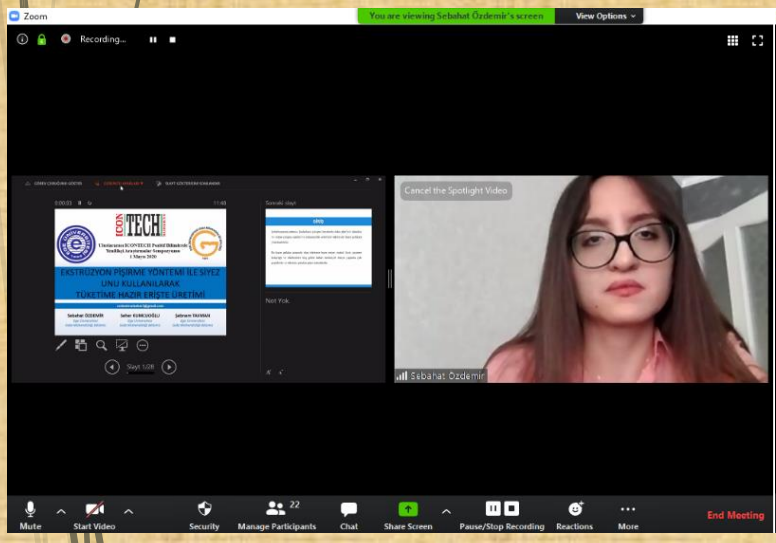
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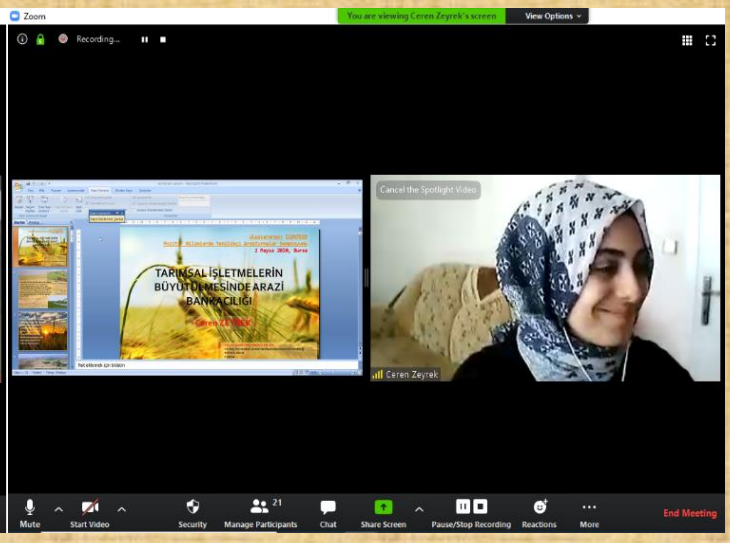
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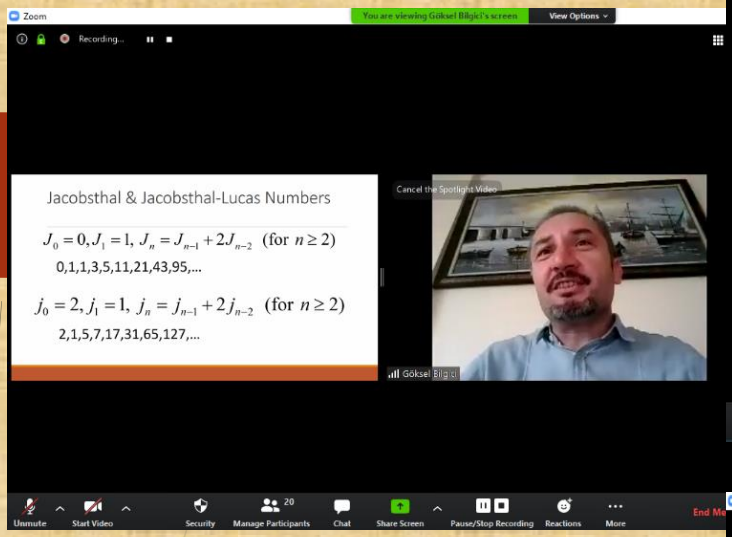
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Jacobsthal & Jacobsthal-Lucas Numbers
$J_0 = 0, J_1 = 1, J_n = J_{n-1} + 2J_{n-2}$ (for $n \geq 2$)
0,1,1,3,5,11,21,43,95,...
$j_0 = 2, j_1 = 1, j_n = j_{n-1} + 2j_{n-2}$ (for $n \geq 2$)
2,1,5,7,17,31,65,127,...
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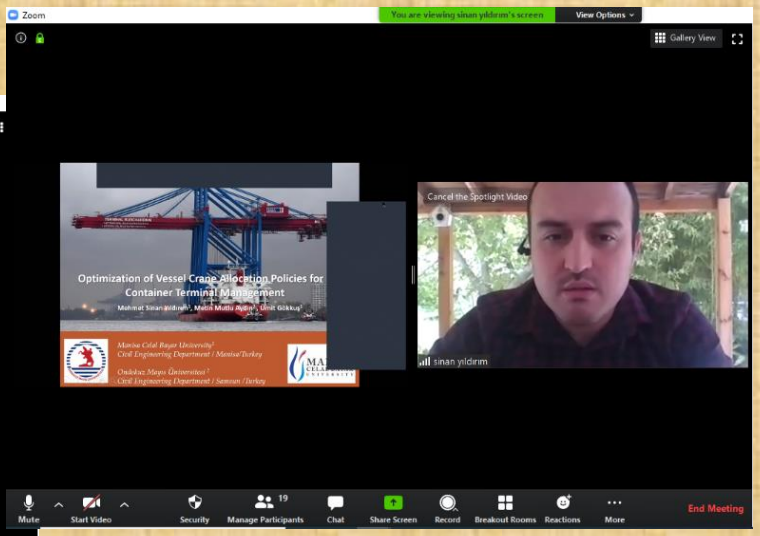
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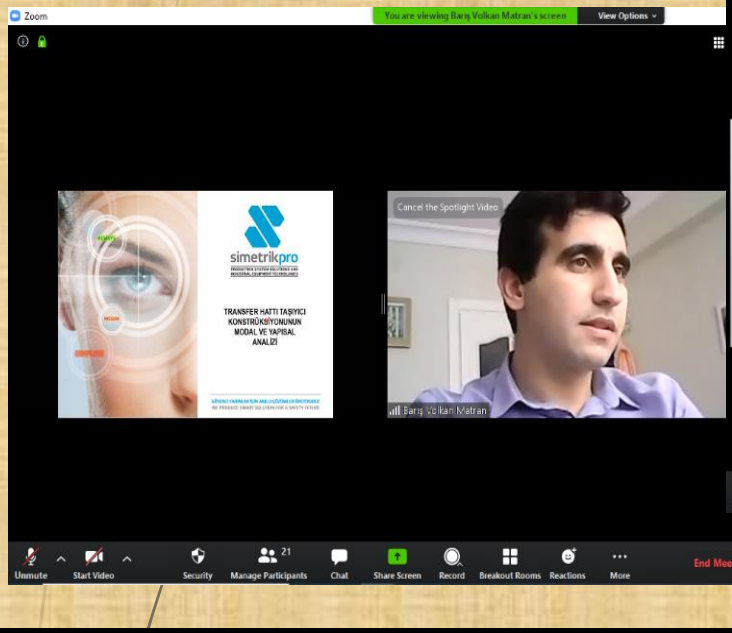
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PREPARATION OF REINFORCED PU FOAMS
Hybrid systems were prepared at different CaSiO3:Fe2O3 filler ratios: 1:1, 1:3 and 3:1 for PU/CaSiO3/Fe2O3.
The following table shows the compositions of the different PU foams.
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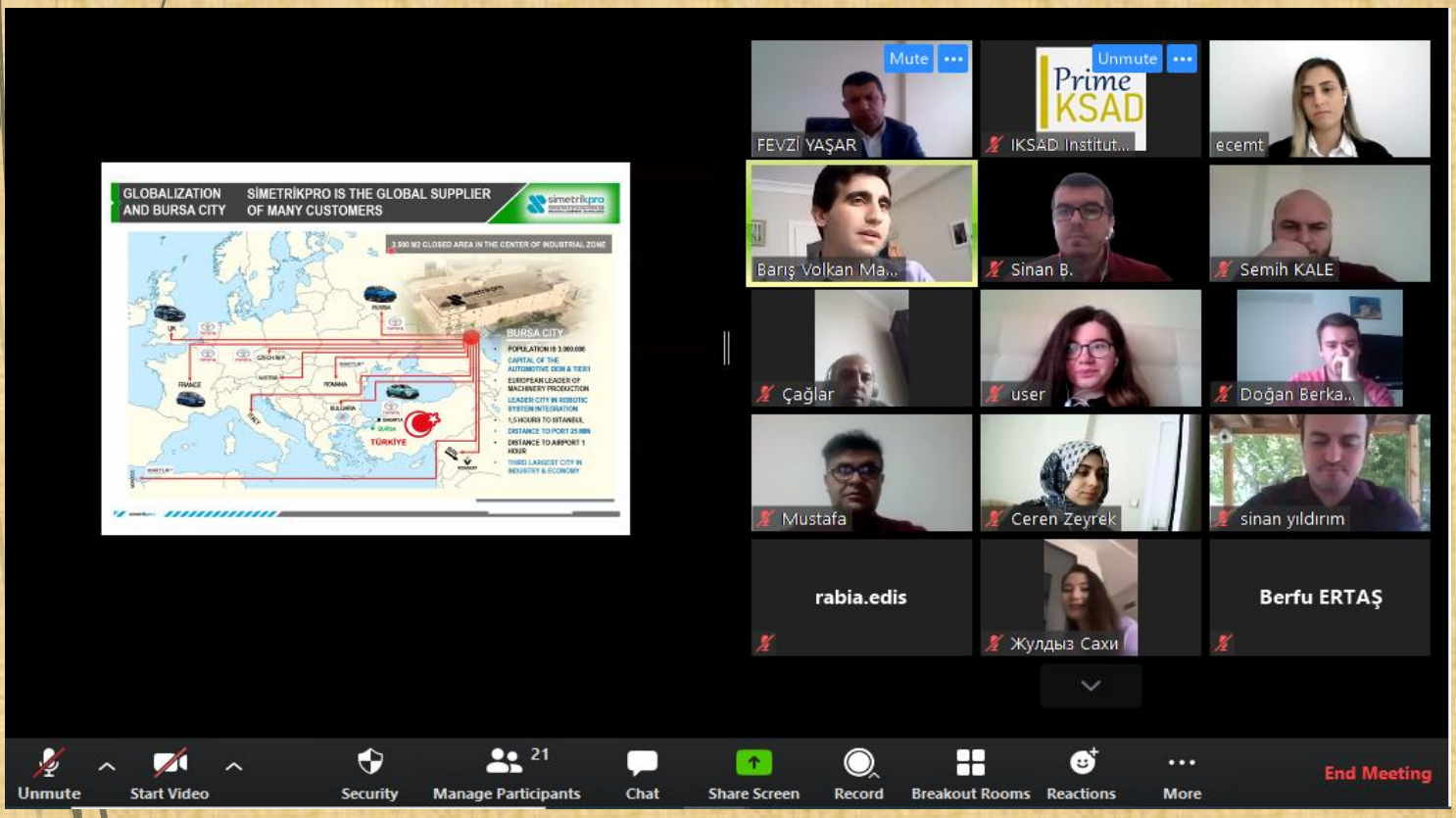
BURSA CITY
POPULATION IS 3.000.000
CAPITAL OF THE AUTOMOTIVE OEM & TIER1
EUROPEAN LEADER OF MACHINERY PRODUCTION
LEADER CITY IN ROBOTIC SYSTEM INTEGRATION
1,5 HOURS TO ISTANBUL
DISTANCE TO PORT 25 MIN
DISTANCE TO AIRPORT 1 HOUR
THIRD LARGEST CITY IN INDUSTRY & ECONOMY
TÜRKİYE
RUSSIA
FRANCE
ROMANIA
BULGARIA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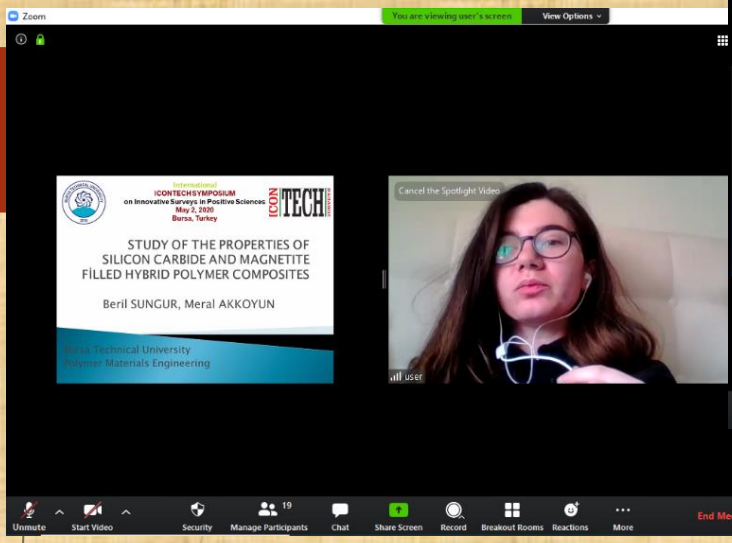
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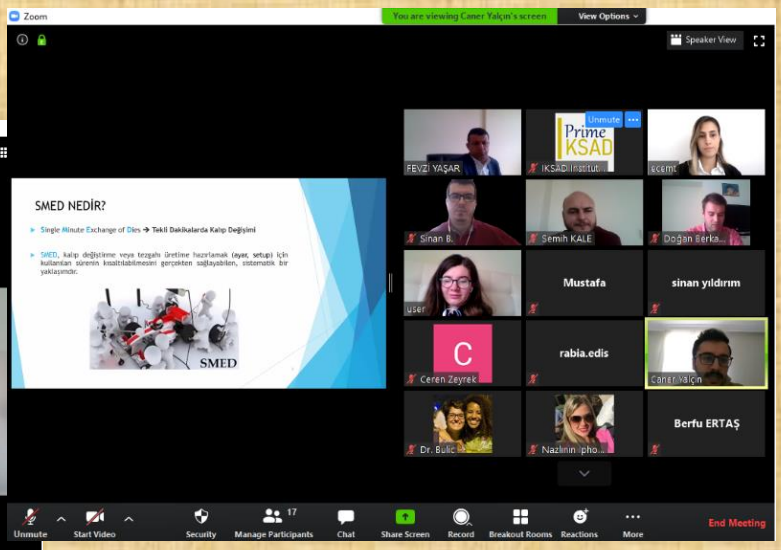
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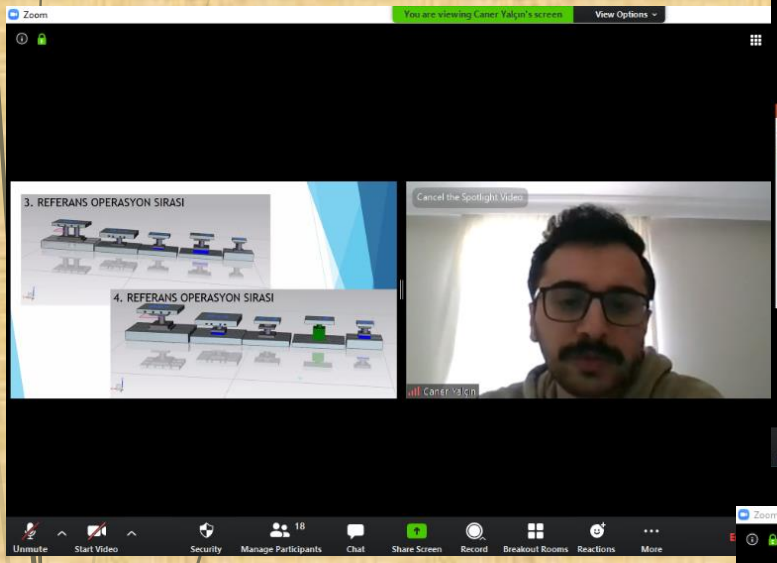
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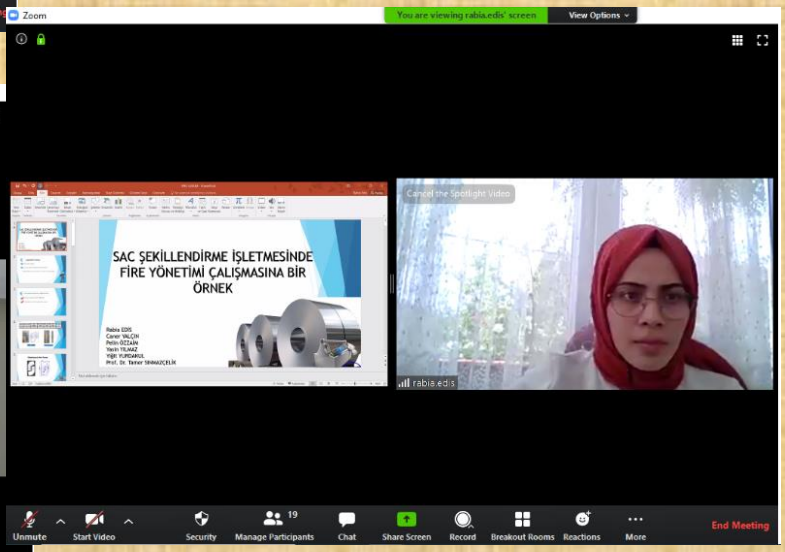
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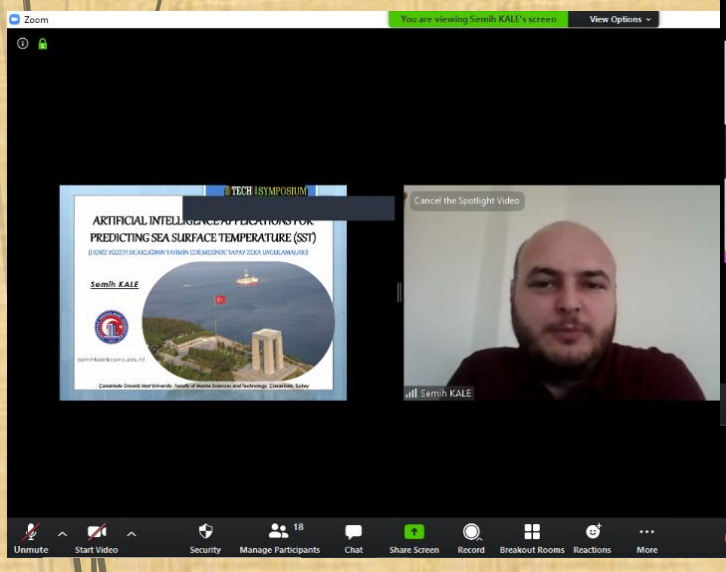
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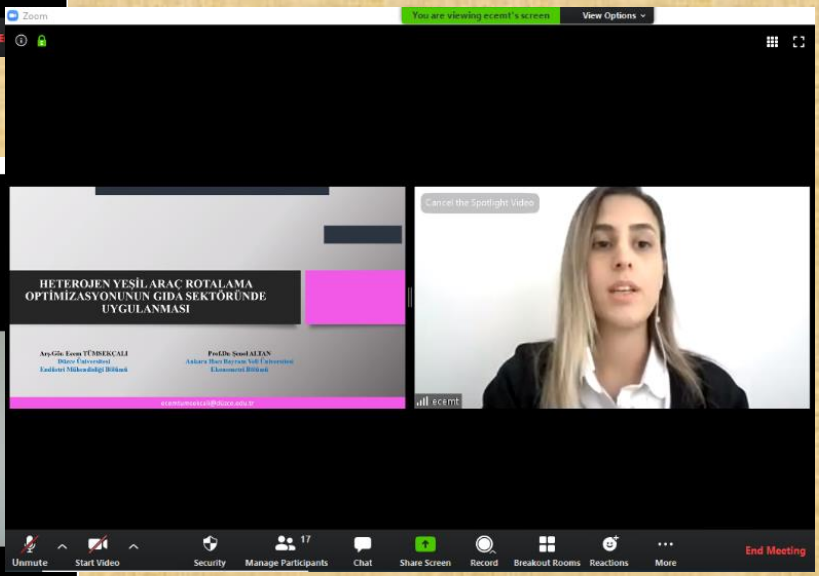
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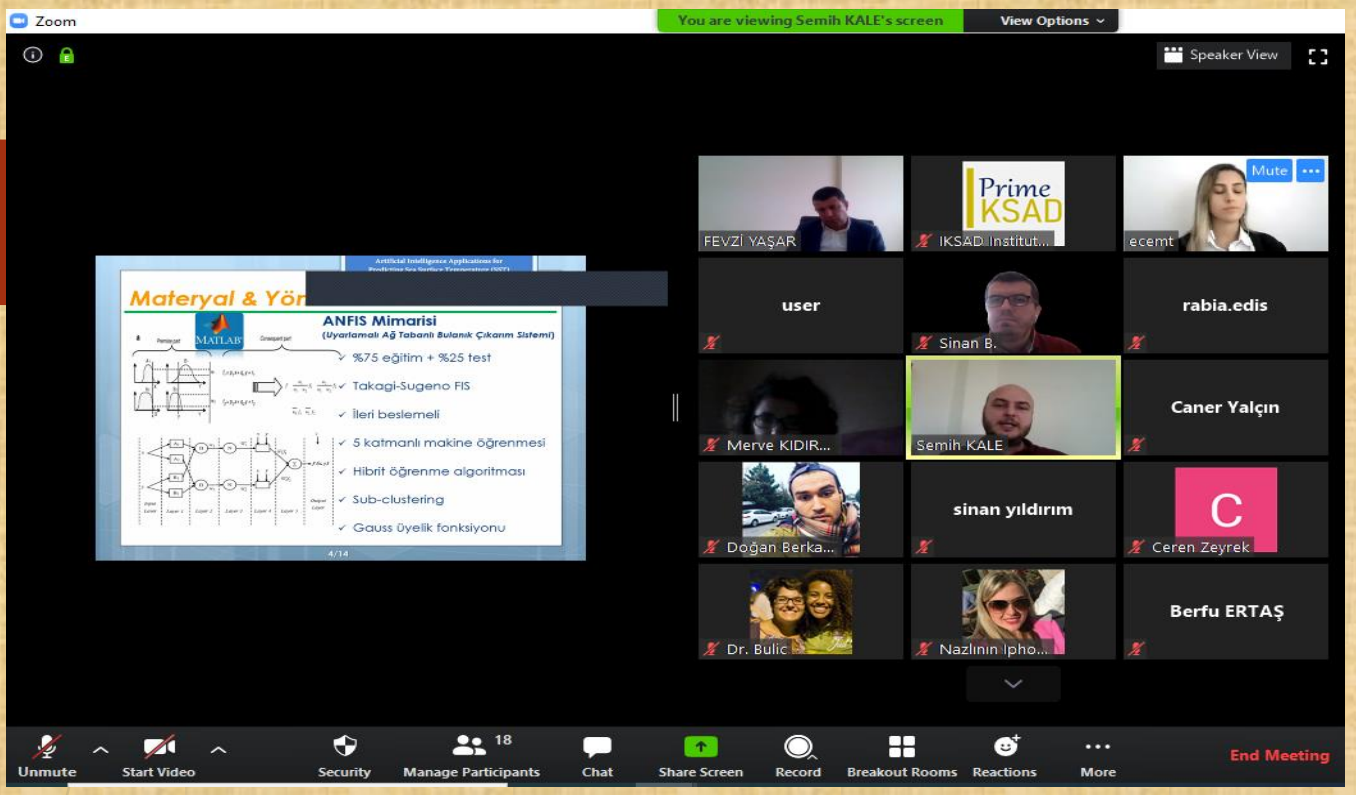
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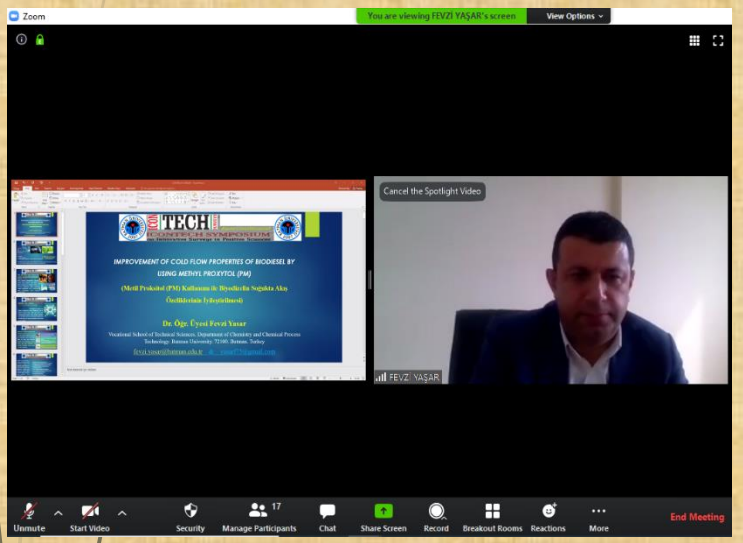
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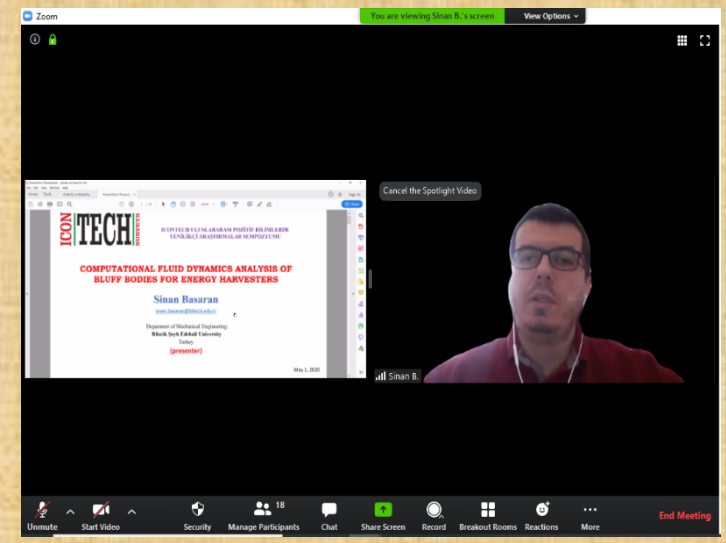
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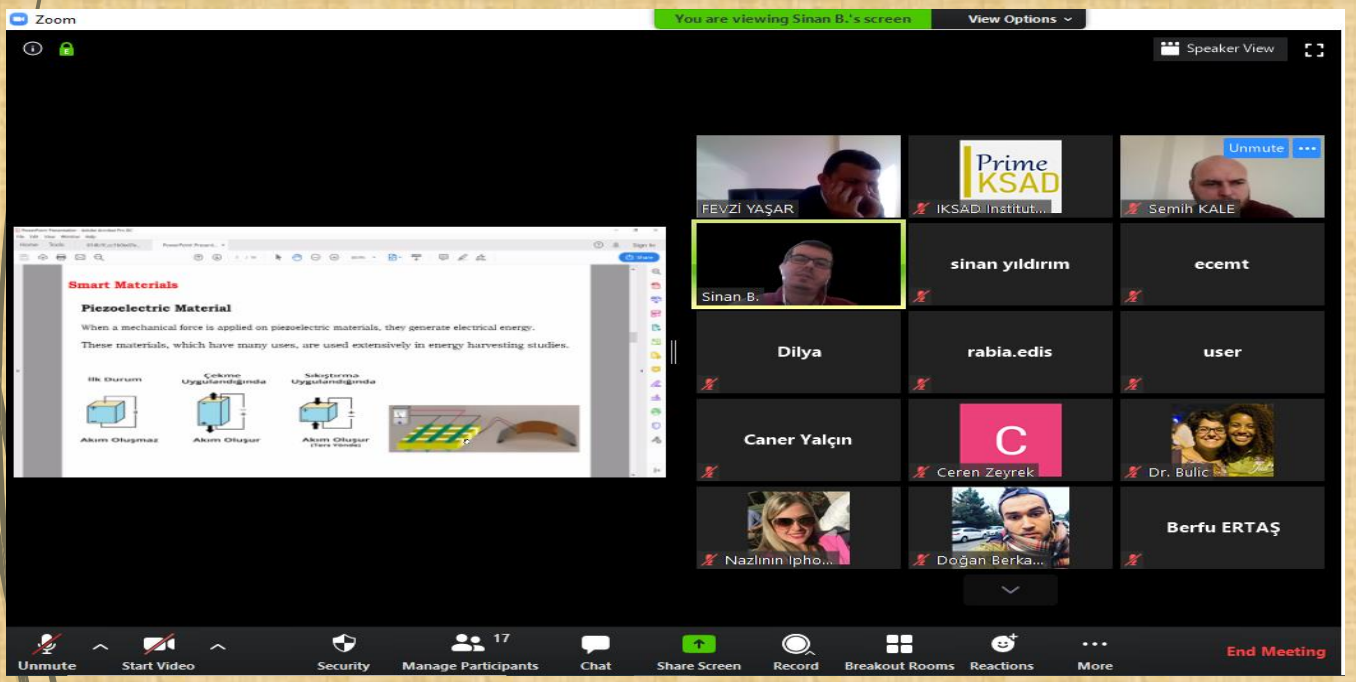
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Piezoelectric Material
When a mechanical force is applied on piezoelectric materials, they generate electrical energy.
These materials, which have many uses, are used extensively in energy harvesting studies.
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CONTENT

AKÇAAĞAÇ ŞURUBUNUN AMFİSİLİN DUYARLILIK POTANSİYELİ VE BAZI PATOJEN BAKTERİLERİN BİYOFİLM OLUŞUMUNUN AZALTILMASI

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ÖZET

Bakterilerin antibiyotik direnci düzenli bir şekilde artmaktadır ve alternatif bir tedavi ajanı olarak antibakteriyel aktiviteye sahip maddeleri araştırmaya acil ihtiyaç vardır. Kuzey Amerika akçaağaç ağacından özsuyu konsantre edilerek hazırlanan akçaağaç şurubu, doğal ve fenolik bileşikler bakımından zengin bir kaynaktır. Bu çalışmanın amacı, 8 tane patojenik test bakterisine karşı akçaağaç şurubu ve amfisilin arasındaki sinerjik aktiviteyi belirlemektir. Akçaağaç şurubu ve amfisilinin antibakteriyel aktivite testi ve kombinasyon analizi 96 kuyucuklu plaka mikrodilüsyon deneyi ile gerçekleştirilmiştir. Minimal inhibitör konsantrasyon (MIC) ve fraksiyonel inhibitör konsantrasyon (FIC) değerleri bu yöntemle belirlenmiştir. Ayrıca amfisilin, akçaağaç şurubu ve akçaağaç şurubu+amfisilin aktivitesini test etmek için agar kuyu difüzyon yöntemi kullanılmıştır. Yapılan çalışma sonucunda, akçaağaç şurubu insan patojeni *Pseudomonas aeruginosa*'ya karşı amfisilin ile güçlü sinerjistik etkileşimin yanı sıra antimikrobiyal aktivite göstermiştir. Denemeye alınan tüm test bakterilerinde 2xMIC konsantrasyonlarında akçaağaç şurubu bakteriyel büyümeyi ve biyofilm oluşumunu da etkili bir şekilde azaltmıştır. Özellikle *S. epidermidis* ve *S. aureus* biyofilm oluşumu yaklaşık yüzde 70 oranında azaltılmıştır. Sonuç olarak, akçaağaç şurubu amfisilin aktivitesini geliştirmiş ve böylece ampisilin kullanımına yardımcı olmuştur. Dolayısıyla akçaağaç şurubunun biyolojik potansiyele sahip olduğu saptanmıştır.

Anahtar Kelimeler: Amfisilin, akçaağaç şurubu, sinerji, biyofilm

AMPICILLIN SUSCEPTIBILITY POTENTIAL OF MAPLE SYRUP AND REDUCTION IN BIOFILM FORMATION OF SOME PATHOGENIC BACTERIA

ABSTRACT

The antibiotic resistance of bacteria has been on a steady rise and there is a urgent need to search for substances with antibacterial activity as an alternative treatment agents. Maple syrup, prepared by concentratingthe sap from the North American maple tree, is a nature and rich source of phenolic compounds. The objective of this study was to determine the synergictic activity between maple syrup and ampicillin against eight pathogenic bacteria. The antibacterial activity testing and combination assay of the maple syrup and ampicillin

were conducted by 96 well plate microdilution assay. Minimal inhibitory concentration (MIC) and fractional inhibitory concentration (FIC) values were determined by this method. In addition, agar well diffusion assay was used to test the activity of ampicillin, maple syrup and maple syrup+ampicillin in combination. Maple syrup exhibited antimicrobial activity as well as strong synergistic interaction with ampicillin against human pathogen *Pseudomonas aeruginosa*. Maple syrup at 2xMIC concentrations efficiently reduced bacterial growth and biofilm formation on all tested bacterial strains. Especially, biofilm formation of *S. epidermidis* and *S. aureus* were decreased at approximately 70 percent. In conclusion, maple syrup improved the activity of ampicillin and thus, confer asistance for the use of ampicillin. Therefore, it has been determined that maple syrup has biological potential.

Keywords: Ampicillin, maple syrup, synergy, biofilm

1. INTRODUCTION

Antibiotics save lives every day, but there is a downside to their ubiquity. High doses can kill healthy cells along with infection-causing bacteria, while also spurring the creation of "superbugs" that no longer respond to known antibiotics. Now, researchers may have found a natural way to cut down on antibiotic use without sacrificing health: a maple syrup extract that dramatically increases the potency of these medicines. [1]. Drug design research faces a long and difficult challenge to overcome drug resistance, whereas drug combinations require no drug modification and lower doses can be used while enhancing the therapeutic potential [2]. It is particular interest to explore the possibility for circumventing resistance to currently used antibiotics by examining a maple syrup - antibiotic combinations on clinical isolates exhibiting a known resistance pattern.Traditional medicinal approaches owe their significance to the bioactive components that have their origin in plant sources, and many are associated with routine dietary habits. The North American maple tree (genus *Acer*) plays a central role in Native Americans' traditional medicine. [3]. The syrup, obtained by concentrating the sap from certain maple species (i.e., the sugar maple, *Acer saccharum* Marsh, and the red maple, *A. rubrum* L.), contains a vast number of natural and process-derived phytochemicals, the majority of which are phenolic compounds. [4]. Frequent and unrestricted use of antibiotics has been associated with the development of antibiotic resistance by microorganisms. Thus, there is a need to find novel antibacterial agents or a combination of agents as the first line of treatment for various infections. The purpose of the current study therefore was to test the antibacterial and antibiofilm activity of maple syrup alone or in combination with antibiotic as ampicillin *in vitro* against selected eight human pathogenic gram positive and gram negative bacteria:*Staphylococcus aureus* (ATCC 25923), *Staphylococcus epidermidis* (ATCC 35984), *Enterococcus faecalis* (ATCC 29212), *Pseudomonas aeruginosa* (ATCC 9027), *Escherichia coli* (ATCC 25922), *Yersinia enterocolitica* (ATCC 9610), *Klebsiella pneumoniae* (ATCC 13883) and *Salmonella typhimurium* (ATCC 14028).

2. MATERIALS AND METHODS

2.1. Materials

Maple syrup and ampicillin (AMP) were respectively purchased from local marked from Canada (Mic Mac Maple syrup) as 40 g/ml and from TCI or Sigma Aldrich. AMP was prepared as stock solutions of 1000 µg/ml and 2000 µg/ml. The following bacteria were used: Gram positive *Staphylococcus aureus* (ATCC 25923), *Staphylococcus epidermidis* (ATCC 35984) and *Enterococcus faecalis* (ATCC 29212), gram negative *Pseudomonas aeruginosa* (ATCC 9027), *Escherichia coli* (ATCC 25922), *Yersinia enterocolitica* (ATCC 9610), *Klebsiella pneumoniae* (ATCC 13883) and *Salmonella typhimurium* (ATCC 14028). Bacterial species were obtained from the Department of Microbiology, Faculty of Medicine, Uludag University.

2.2. Growth Conditions

For antibacterial assay, a single colony in Luria- Bertani (LB) agar plates of all strains was transferred to Muller Hinton broth (MHB) and then incubated at 37 ^{o}C for 24 h. After incubation it was adjusted to a concentration of 1x10^{8} colony forming units per ml (CFU/ml) to add Muller Hinton agar (MHA). For antibiofilm assay, all the bacterial strains used in this study were cultured overnight at 37 °C in LB medium.

2.3. Antibacterial activity

MHA and MHB were used to evaluate the activity of the maple syrup and AMP against tested bacteria; this employed the agar-well diffusion and 96 well plate microdliution technique. Briefly, 100 µl of standardized suspension of examined bacteria 1×10^{8} CFU/ml spread on MHA plates. A total 100 µl amount of the maple syrup and AMP was transferred into each corresponding well. After 24 hours incubation at 37 ^{o}C, the antibacterial activity of syrup, AMP and combination were assessed by determining the diameter of inhibition zone in centimeter (mm) against the examined bacteria [4]. The bacterial growth-inhibitory ability of AMP and maple syrup were determined by microtiter MIC determination in MHB II (Muller Hinton Broth II) according to CLSI guidelines [5].

2.4. Checkerboard Assay

Serial two-fold dilutions of the AMP in cation-adjusted MHB II were placed alone and in combination with maple syrup in wells of a microtiter plate and inoculated with an appropriate bacterial inocula so that each well contained approximately 5 x 10^{5} CFU/ml. After incubation at 37°C for 24 h, the MIC was determined as the well containing the lowest concentrations of the two compounds (maple syrup and AMP) in which no visible growth was observed. The synergistic interactions were expressed as the fractional inhibitory concentration index (FICI) as follows: FIC index = FIC A + FIC B, where FIC A is the MIC

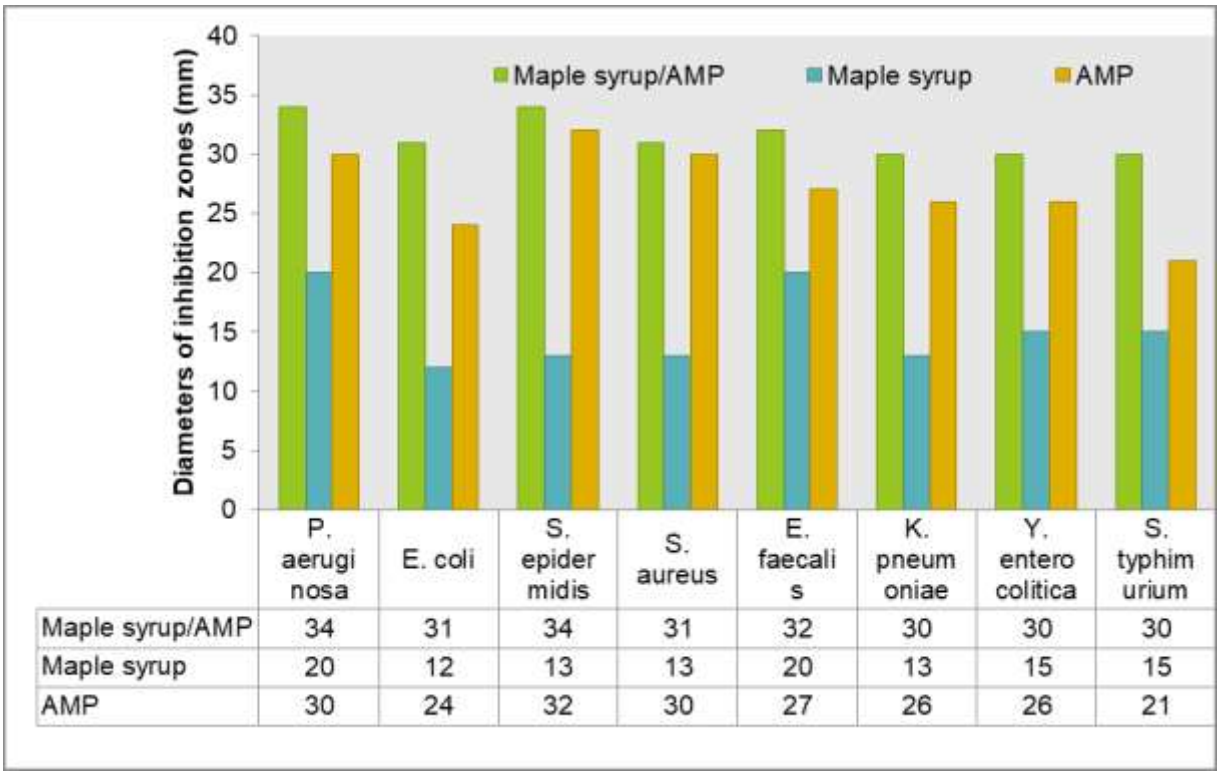
of antibiotic A in the combination/MIC of drug A alone, and FIC B is the MIC of drug B in the combination/MIC of peptide B alone [6]. The peptide-antibiotic interaction is defined as synergy when the fractional inhibitory concentration (FIC) index is ≤0.5; as additive with an FIC index >0.5 but ≤1; as indifference with an FIC index of >1 but <4, and as antagonism with an FIC index ≥4.

2.5. Biofilm and Growth Assay

The effect AMP and maple syrup on the biofilm formation was determined by quantifying the biofilm biomass through microtiter plate (MTP) assay [7]. 100 µl of different concentrations maple syrup and AMP were added to wells prior to bacteria inoculation. Overnight cultures of bacterial strains were adjusted to $1x10^6$ CFU/ml and then 100 µl of inocula were added into MTP contained medium. MTPs were incubated in 37^oC for 24 h. After incubation, bacterial OD 600 values were determined and then MTPs were emptied by removing the media along with free-floating planktonic cells and the wells were gently rinsed twice with water. The surface-attached cells were stained with 1% crystal violet solution. After 30 min, crystal violet solution was discarded completely and wells were filled with 95% ethanol to solubilize crystal violet from the stained cells. The biofilm biomass was then quantified by measuring the absorbance at OD 590 nm using a UV-visible spectrophotometer and % inhibition were calculated. Experiment was repeated at two times and results were expressed average of values.

3. RESULTS AND DISCUSSION

Inhibition diameters of maple syrup, AMP and maple syrup + AMP were determined by using agar well diffisuion assay. According to results, maple syrup+AMP were found more effective than maple syrup or AMP against tested pathogens: Gram positive *Staphylococcus aureus* (ATCC 25923), *Staphylococcus epidermidis* (ATCC 35984) and *Enterococcus faecalis* (ATCC 29212), gram negative *Pseudomonas aeruginosa* (ATCC 9027), *Escherichia coli* (ATCC 25922), *Yersinia enterocolitica* (ATCC 9610), *Klebsiella pneumoniae* (ATCC 13883) and *Salmonella typhimurium* (ATCC 14028). As can be seen on Figure 1, maple syrup + AMP combination were most effective on *P. aeruginosa* (34 mm) and *S. epidermidis* (34 mm). Maple syrup (40 g/ml) inhibitory effect were found less than AMP (2 mg/ml) against all tested bacterial strains.



	P. aeruginosa	E. coli	S. epidermidis	S. aureus	E. faecalis	K. pneumoniae	Y. enterocolitica	S. typhimurium
Maple syrup/AMP	34	31	34	31	32	30	30	30
Maple syrup	20	12	13	13	20	13	15	15
AMP	30	24	32	30	27	26	26	21

Figure 1. Inhibitory effects of maple syrup, AMP and maple syrup+ AMP combination against tested bacterial strains.

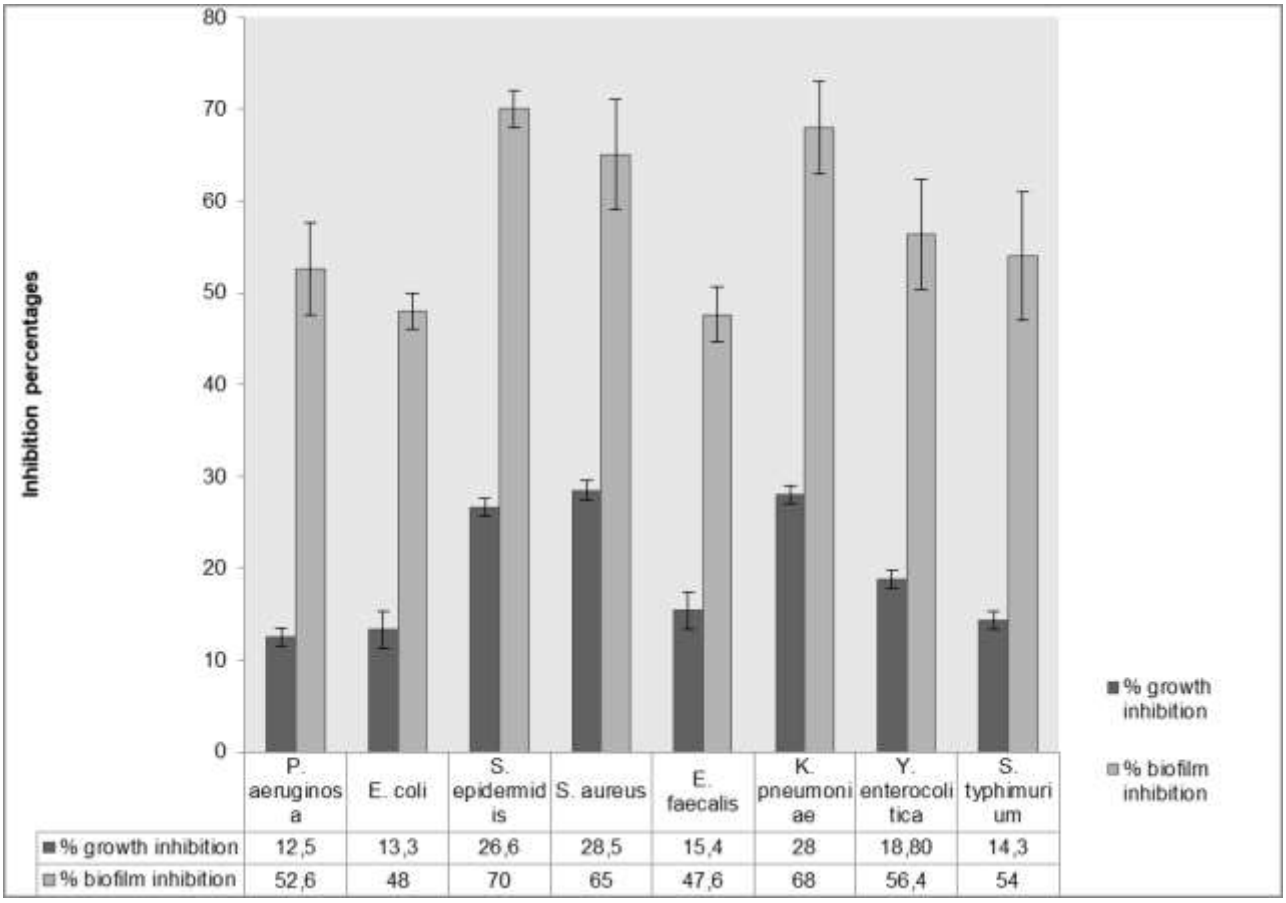
The MICs of antibiotic (AMP) and maple syrup were determined by the MHB microdilution technique against tested pathogens. All MICs of maple syrup were found to be somewhat higher. To test the synergy between AMP and maple syrup, it was adapted the checkerboard methodology that was widely used to determine interactions between antibacterial compounds. Based on the initial results, the most commonly used antibiotic AMP were combined with the maple syrup. towards tested pathogens to give the results shown in Tables 1. In all cases, it was observed either synergy, i.e. a fractional inhibitory concentration (FIC) <0.5, indicating that the MIC of each compound in combination was decreased at least 4 fold as compared to the compounds used alone, near synergy (FIC <0.5) or additive interactions (FIC = 0.5-4).

Synergistic effects (FICI < 0.5) were seen against *P. aeruginosa* as of the AMP-maple syrup combinations (2,5 g/ml) (Table 1). Maple syrup showed strong synergistic acitivity with AMP against *P. aeruginosa*. As judged from the results obtained with 2,5 g/ml maple syrup concentration, the most pronounced synergistic effect of AMP were found. On the other bacterial strains, additive interaction were found between (1-2,0156).

Table 1. FIC index of AMP+Maple Syrup combination against pathogenic bacteria

Bacterial strains	**FICI**	**MICs (combination) (mg/ml)**		**MICs alone (mg/ml)**	
		AMP	**Maple syrup**	**AMP**	**Maple syrup**
P. aeruginosa	0,25	0,125	2,5	1	20
E. coli	1,125	0,0625	1,25	0,06	10
S. epidermidis	2,0156	0,0625	0,312	0,03	20
S. aureus	1,0156	0,125	0,312	0,13	20
E. faecalis	1, 0156	0,125	0,312	0,13	20
K. pneumoniae	1	0, 25	5	0,5	10
Y. enterocolitica	1,25	0,5	5	0,5	20
S. typhimurium	1,125	0,25	2,5	0,25	20

Biofilms are a thin layer of bacteria that are often resistant to medicine, and which are common in severe infections such as catheter-associated urinary tract infections (UTIs). The researchers tested the combined effect of maple syrup extract and the common antibiotics ciprofloxacin and carbenicillin (4). They found that together, the two substances created a synergistic, destructive effect on biofilms. In our study, it was found that maple syrup is effective on biofilm formation of all tested bacterial strains (Figure 2). When bacterial strains were grown, biofilm formation of them was destroyed more than 50 percent on all strains. The most effective inhibition on biofilm formation of maple syrup was found against *S. epidermidis* (70 %) and *K. pneumoniae* (68 %).



	P. aeruginosa	E. coli	S. epidermidis	S. aureus	E. faecalis	K. pneumoniae	Y. enterocolitica	S. typhimurium
% growth inhibition	12,5	13,3	26,6	28,5	15,4	28	18,80	14,3
% biofilm inhibition	52,6	48	70	65	47,6	68	56,4	54

Figure 2. Biofilm and growth inhibition percentages of maple syrup against pathogen bacteria.

CONCLUSIONS

In summary, synergistic combinations have proved to be the powerful therapy which can overcome the disadvantage of individual antibiotics and provide new alternatives against pathogens. More researches should be carried out to discover new synergistic combination. This combination therapy allows the use of lower concentrations of maple syrup and restores the effectiveness of AMP as antibiotic.

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HAVA-JETLİ TEKSTÜRE PBT İPLİKLERİN MEKANİK ÖZELLİKLERİ VE KARARSIZLIK DAVRANIŞLARININ İNCELENMESİ

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ÖZET

Hava-jetli tekstüre işlemi, sentetik filamentlerin iplik içerisindeki düzenli yerleşimlerini mekanik yolla değiştirerek, bu filamentleri birbirine karışmış, hacimli, doğal ipliklere benzer bir yapıya dönüştürür. Bu teknikte, uygulanan aşırı beslemenin yardımıyla her çeşit filament, tekstüre jetinden uygulanan süpersonik hava akımının tesiriyle karıştırılabilir. Hava-jetli tekstüre işleminde jetten tekstüre olarak çıkan ipliğe, alım silindiri ile sevk silindiri arasında bir mekanik germe işlemi uygulanır. Mekanik germenin amacı, tam olarak ilmek oluşturamamış filamentlerin çözülmesi ve ilmek oluşturabilmiş filamentlerin daha iyi kilitlenerek ipliğin mekanik özelliklerini daha kararlı hale getirmektir. Hava-jetli tekstüre ipliklerin yapısında bulunan ilmeklerin bir kısmı uygulanan kuvvetlerin etkisiyle yok olabilir, iplik üzerinde kalan ilmeklerin miktarı bu ilmeklerin "kararlılığı" ile ilişkilidir. Poliesterler ana zincirlerinde ester bağları bulunduran sentetik liflerdir. Bu lifler olumlu performans özellikleri nedeniyle konvansiyonel ve endüstriyel alanlarda sıklıkla tercih edilmektedir. Farklı poliester çeşitleri arasında, polibütilen tereftalat (PBT) lifleri özellikle iyi toparlanma davranışının istendiği uygulamalarda tercih edilmektedir. Bu çalışmada hava-jetli tekstüre PBT ipliklerin mekanik özellikleri ve kararsızlık davranışları incelenmiştir. Yapılan ön denemelerde, mekanik germe oranının %6'nın üzerinde olduğu durumlarda iplik yapısında deformasyon gözlenmiştir. Bu nedenle bu çalışmada en yüksek %6 olacak şekilde 4 farklı mekanik germe (%0-2-4-6) ve 3 farklı aşırı besleme oranında (%20-40-60) hava-jetli tekstüre PBT iplikler üretilmiştir. Üretilen bu numunelerin, iplik numaraları, mekanik özellikleri ve elastik toparlanma davranışları incelenmiştir. Çekme ve elastik toparlanma deneylerinden elde edilen sonuçlar optik mikroskop deneyleriyle ilişkilendirilerek açıklanmıştır. Yapılan deneyler sonucunda, hava-jetli tekstüre PBT ipliklerde aşırı besleme oranındaki artışa bağlı olarak ilmekli yapıda bir artış gözlenmiştir. Bu durum, numunelerin iplik numarası ve kopma uzaması değerlerinde bir artışa, elastik toparlanma davranışlarında ise azalmaya neden olmuştur. En az ilmekli yapının gözlendiği %20 aşırı besleme ile üretilen numunelerde filamentler iplik eksenine olan paralelliklerini kısmen korumuştur. Dolayısıyla bu numuneler

için hava-jetli tekstüre iplik yapısından ziyade filamentleri meydana getiren molekül zincirlerinin özellikleri ön plana çıkmış ve en iyi toparlanma bu iplik grubunda gözlenmiştir.

Anahtar Kelimeler: Hava-jetli Tekstüre, Polibütilen Tereftalat, Mekanik Özellik, Kararsızlık Davranışı

INVESTIGATION OF MECHANICAL PROPERTIES AND INSTABILITY OF AIR-JET TEXTURED PBT YARNS

ABSTRACT

Air-jet texturing mechanically alters the parallel arrangement of the synthetic filaments within the yarn, transforming them into a bulky, spun yarn like structure. In this technique, with the help of the applied overfeed and supersonic airflow, all kinds of filaments can be textured. In air-jet texturing, the textured yarn is subjected to a slight stretch between two feed-roll units after the exit of the jet. The purpose of this stretch is to stabilize the mechanical properties of the textured yarn by anchoring the loops in the core. Some of the loops in the structure of the air-jet textured yarns can be destroyed by the effect of the applied forces. The amount of the loops remaining on the thread is related to the "stability" of these loops. Polyesters fibres are synthetic materials that contain ester bonds in their main chains. These fibres are especially preferred in conventional and industrial applications due to their favourable properties. Among all the polyester fibres, polyethylene terephthalate (PBT) is generally used where elastic behaviour is essential. In this study, mechanical properties and instability of the air-jet textured PBT yarns were investigated. The preliminary studies showed that mechanical stabilization over a 6% stretch ratio deformed the yarn structure. For this reason, PBT yarns were textured with 4 different mechanical stretch (0-2-4-6%) and 3 different overfeed ratios (20-40-60%). Yarn counts, mechanical properties and instability of the yarns were investigated. The results were discussed concerning the optical microscope images. It was concluded that increasing the overfeed, increased the looped structure. This leaded an increase in the yarn count and breaking elongation, while a decrease in the elastic recovery. Filaments in the samples with the least looped structure (yarns textured with 20% overfeed) maintained their parallel arrangement regarding the yarn axis. Therefore for these samples, the properties of their molecular structure came into prominence and the best elastic recovery behaviour was observed in this group of samples.

Keywords: Air-Jet Texturing, Polybutylene Terephthalate, Mechanical Property, Instability

ÜÇ BOYUTLU ÜRETİM TEKNİĞİ KULLANILARAK ÜRETİLEN NUMUNELERİN ÇEKME VE EĞİLME KUVVETLERİ AÇISINDAN KARŞILAŞTIRILMASI

Onur Tatlı
Empo Otomotiv Yedek Parça Sanayi ve Ticaret Ltd Şti.

Hande Güler Özgül
Uludağ Üniversitesi Mühendislik Fakültesi Otomotiv Mühendisliği Bölümü

Hüseyin Özgül
Dorukmak Makine İnş.Nak.San.Tic.Ltd.Şti

ÖZET

Bu çalışmada, üç boyutlu yazıcı ile FDM üretim tekniği kullanılarak üretilen deney numunelerinde farklı kesitlerin etkisi incelenmiştir. İki farklı kesit oluşturmak amacıyla, iki farklı dolgu geometrisi ile üretim yapılmıştır. Seçilen dolgu geometri tipleri; "ızgara ve giroid" ve kullanılan dolgu malzemesi PLA' dır. Üretilen numunelere daha sonra çekme ve eğilme deneyleri uygulanmış ve belirlenen dolgu geometrisi tipleri için maksimum çekme ve eğilme kuvvetleri belirlenmiştir. Sonuç olarak, maksimum çekme kuvvetine sahip geometri "ızgara" iken, maksimum eğilme kuvvetine sahip geometri ise "giroid" olarak tespit edilmiştir.

Anahtar kelimeler: Üç boyutlu yazıcı, Çekme Deneyi, Eğilme Deneyi

COMPARISON OF THE TENSILE AND BENDING FORCES OF THE SAMPLES PRODUCED BY THREE DIMENSIONAL PRINTING TECHNIQUES

ABSTRACT

In this study, the effect of different infill geometries on the experimental samples produced by using FDM production technique with a three dimensional printer was investigated. In order to create two different sections, the productions were made with two different infill geometries. The infill geometries are "grid and gyroid" and the infill material is PLA. Tensile and bending tests were applied to the produced samples and maximum tensile and maximum bending forces were determined for the specified infill geometries. As a result, the geometry with the maximum tensile force was determined as "grid" while the geometry with the maximum bending force was determined as "gyroid".

TARIM 4.0 İLE SÜRDÜRÜLEBİLİR BİR GELECEK

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ÖZET

Son yıllarda dünya nüfusunda hızlı artış gözlemlenmiştir. Bu artış, insan hayatının idamesi için en önemli yapı taşı olan beslenme sorununu beraberinde getirmekte ve soruna sürdürülebilir bir çözüm arayışı bulma zorunlu hale gelmektedir.

7.7 milyar olan dünya nüfusu 2050 yılında 9.7 milyar kişiye kadar ulaşacağı tahmin edilmekte ve bununla beraber beslenme gereksiniminin giderilmesi için tarımsal üretimin %70 oranda arttırılması gerektiği düşünülmektedir. Günümüzde değişim gösteren iklim koşullarında bu tarımsal üretim artışının nasıl elde edileceği ve nasıl daimi olacağına bulunacak çözüm aynı zamanda beslenme sorununu azaltacaktır. Geleneksel tarım yöntemleri artık tam olarak yeterli değildir. Bazı ülkelerde Tarım 4.0 sistemleri ile randıman arttırıcı ve maliyetleri düşürücü uygulamalara yoğunluk verilmektedir. Bu uygulama, tarım sektörünün dijital hale geçmesini ifade eder. Bu nedenle üretimde yararlanılan su, gübre, yakıt gibi unsurların daha az olması ve aynı zamanda üretim sonucu ortaya çıkan ürününün daha fazla elde edilmesi bu süreç ile birlikte mümkün olacaktır.

Bu araştırmada, tarım sektöründe daha verimli, daha çevreci, sürdürülebilir büyüme, bilgi, yenilik ve teknolojiye dayalı akıllı büyüme sağlamak amacıyla ülkemizin Tarım 4.0 uygulamalarına geçmesinin gerekliliğinden bahsedilmiştir. Aynı zamanda tarım sektörü ve tarımsal ürün ihracatı bakımından önemli pozisyonda olan Hollanda, Tayvan, İsrail, Japonya, ve Amerika Birleşik Devletleri'nin akıllı tarım uygulama deneyimleri incelenmiş ve Türkiye'nin genel durum çözümlemesi yapılmıştır.

Anahtar Kelimeler: Akıllı Tarım, Tarım 4.0, Tarımda Makinalaşma, Sürdürülebilir Tarım

A SUSTAINABLE FUTURE WITH AGRICULTURE 4.0

ABSTRACT

Rapid increase in world population has been observed in recent years. This increase brings the nutritional problem, which is the most important building block for the maintenance of human life, and it is imperative to find a sustainable solution to the problem.

The world population, which is 7.7 billion, is estimated to reach 9.7 billion people in 2050, and it is thought that agricultural production should be increased by 70% in order to meet the nutritional needs. The solution to find out how to achieve this agricultural production increase and how it will be permanent in the changing climate conditions today will also reduce the nutritional problem. Traditional farming methods are no longer enough. In some countries, practices are given to increase efficiency and reduce costs with Agricultural 4.0 systems. This practice refers to the digitalization of the agricultural sector. For this reason, it will be possible with the process such as less water, fertilizer, fuel used in production and at the same time to obtain more of the product resulting from production.

In this study, the necessity of our country to adopt Agriculture 4.0 practices in order to achieve more efficient, more environmentally friendly, sustainable growth, smart growth based on knowledge, innovation and technology in the agricultural sector was mentioned. At the same time the agricultural sector and that a significant position in terms of exports of agricultural products Netherlands, Taiwan, Israel, Japan, the United States and examined the UK's smart farming practices and experiences in analyzing the overall situation of Turkey is made.

Keywords: Smart Agriculture, Agriculture 4.0, Mechanization in Agriculture, Sustainable Agriculture

BRANGUS IRKI SIĞIRLARDA 2-HİDROKSİ-4-(METİLTİYO) BUTANOİK ASİT İZOPROPİL ESTER(HMBİ) KULLANIMININ BESİ PERFORMANSI VE BAZI KAN PARAMETRELERİ ÜZERİNE ETKİSİ

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ÖZET

Bu araştırmada HMBi'nin Brangus ırkı erkek besi danaları rasyonlarında kullanılmasının, canlı ağırlık artışları, cidago ve vücut uzunlukları ile bazı kan parametreleri üzerine olan etkileri araştırıldı.

Araştırma Bursa İli Mustafakemalpaşa İlçesi'ne bağlı Boğaz Mahallesi'nde bulunan Dört Mevsim Besi ve Yem Sanayi Ticaret Anonim Şirketi'ne ait besi işletmesinde Eylül 2018 yılında başlanıp toplam 7 ay süresince gerçekleştirildi. Araştırmanın hayvan materyali, Ağustos 2018'de Brezilya'dan ithal edilen ortalama 305 kg/hayvan canlı ağırlığına sahip, yaklaşık 9 - 10 aylık yaşta 80 baş Brangus ırkı erkek besi sığırları herhangi bir özellik gözetilmeksizin rastgele kontrol ve uygulama grubu olarak iki gruba ayrıldı. Çalışmada kontrol ve uygulama grubu olarak sınıflandırılan hayvanlara işletmedeki temel rasyon programı uygulandı. Bu rasyona ek olarak muamele grubuna rasyon kuru maddesinin % 0.20 oranında HMBi ilavesi yapıldı.

Her iki grupta da besi süresince 30'ar gün aralıklarla canlı ağırlık tartımı, vücut uzunluğu ve cidago yüksekliği ölçümleri ve son tartım sonrasındaki kesim sırasında kan alımı gerçekleştirildi. Kanda albümin, protein, glikoz, kolesterol, trigliserit, BUN, ALT, AST, parametreleri incelendi. Araştırmada elde edilen veriler IBM SPSS 23.0 paket programında istatistiksel olarak analiz edildi.

Kontrol ve uygulama gruplarında, besi dönemi boyunca, besi performansı (1.57 ve 1.71 kg) ve cidago yüksekliği (125.70 ve 129.00 cm) bakımından gruplar arasındaki fark istatistiki olarak önemli ($P<0.01$), vücut uzunluğunda ise (97.70 ve 97.91 cm) gruplar arasındaki farklılık önemsiz bulundu ($P>0.05$). Bazı kan parametreleri üzerine gerçekleştirilen analiz sonuçlarında; albümin (3.45 ve 3.55 g/dL), glikoz (190.00 ve 183.20 mg/dL), kolesterol (124.33 ve 124.00 mg/dL), trigliserit (13.93 ve 13.93 mg/dL), BUN (9.35 ve 9.84 mg/dL),

ALT (50.80 ve 46.47 IU/L) ve AST 152.60 ve 146.07 IU/L) için gruplar arası farklılık istatistiki olarak önemsiz bulundu. Buna karşın protein (8.35, 7.92 g/dL) için ise gruplar arası farklılık istatistiksel anlamda önemli bulundu. (P<0.05).

Araştırma sonunda HMBi'nin rasyonlarda kullanılmasının besi performansına olumlu etkisi olduğu tespit edilmiş olup; karkas özellikleri üzerinde de çalışmaların yapılmasının gerekliliği ortaya çıkmıştır.

Anahtar Kelimeler: besi performansı**,** GH, HMBi, IGF-1, metiyonin.

Not: Bu çalışma; Balıkesir Üniversitesi BAP Proje koordinasyonu tarafından 2018/067 nolu proje olarak desteklenmiştir.

THE EFFECT OF 2-HIDROKSI-4-(METILTIYO) BUTANOIK ASIT IZOPROPIL ESTER (HMBI) USE ON FATTENING PERFORMANCE AND SOME BLOOD PARAMETERS IN BRANGUS BREED CATTLE

ABSTRACT

The aim of this research was to reveal the effects of use of HMBi in the rations of male Brangus fatling calves over the animals' live weight gain, cidago and body length, and certain blood parameters.

The research was initiated in September 2018 at the livestock establishments of Four Seasons Livestock and Feed Industry and Trade Incorporation located in Bursa, Mustafakemalpaşa Boğaz Neighbourhood and the research took a period of 7 months. The live materials of the research consisted of a total of 80 calves of 9 – 10 months of age imported from Brasil in August 2018, with an average live weight of 305 kg. These animals were randomly separated into two groups of control and experiment without regards to any of their properties. Both groups were given the basic ration program used by the establishment. The experiment group was additionally given HMBi additive with the ratio of 0.20 % of their ration dry matter.

Animals in both control and experiments groups were measured in terms of feeding performance (1.57 and 1.71 kg, respectively) and cidago height (125.70 and 129.00 cm, respectively), and the differences between the groups in terms of these performances were found to be statistically significant (P<0.01). The performance difference between the groups regarding the body length (97.70 and 97.91 cm, respectively), on the other hand, were found to be statistically insignificant. The results of analysis performed on a series of blood parameters are as follows: albumin (3.45 and 3.55 g/dL), glucose (190.00 and 183.20 mg/dL), cholesterol (124.33 and 124.00 mg/dL), triglyceride (13.93 and 13.93 mg/dL), BUN (9.35 and

9.84 mg/dL), ALT (50.80 and 46.47 IU/L) and AST (152.60 and 146.07 IU/L). All of these differences were found to be statistically insignificant. The blood protein levels (8.35 and 7.92 g/dL for control and experiment groups, respectively) were found to be statistically significant ($p<0.05$).

The results of the research show that use of HMBi as part of the fatling ration had a positive effect on the fattening, and has revealed the need for future research on its effects over the carcass properties.

Keywords: Fattening performance, HMBi, methionine.

Note: This work; It was supported by Balıkesir University BAP Project coordination as the project numbered 2018/067.

İNSAN TERİNDEN GLİKOZ, pH, LAKTAT, KLORÜR ANALİZİ YAPAN DERİ ÜSTÜNE YAPIŞTIRILABİLEN AKILLI BANT

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ÖZET

Bu çalışmamızda insan terinden alınan örnekler üzerinde yapılan analizler ile, terin pH, laktat, klorür, glikoz maddelerinin ölçülebilmesi için çeşitli araştırmalar yapılmıştır. Bu araştırmada öncelikli olarak reaktifler üzerinde çalışma gerçekleştirilmiştir ve daha sonra indikatörlerin geliştirilmesi sağlanmıştır. Geliştirilen bu indikatörlerin ter ile yapmış olduğu değişimlerin ölçülebilmesi için de yapay zeka destekli bir arayüz oluşturulmuş ve programlaması yapılmıştır. Yapısında mikron kanallar inşa ederek tasarladığımız ana malzememizin içine entegre edilen reaktifler ile kullanışlı, taşınabilir bir kit yapılması hedeflenmiştir. Bu sistemin çalışma prensibi, kullanıcının kiti cilt üzerine yapıştırdıktan sonra cihazın içine giren ter örneklerinin reaktifler ile birleşip reaksiyona girmesi ve bir telefon kamerası vasıtası ile değişimlerin telefona aktarılmasıdır. Yapmış olduğumuz akıllı telefon destekli uygulamamız önceden uv-spektrofotometre ile referanslınmış değerler üzerinde karşılaştırma yaparak bize terin içeriği hakkında bilgi vermektedir.
Çalışmalarımızda kullanılmak üzere hazırlamış olduğumuz reaktiflerin ter ile reaksiyona girmesi ile birlikte almış olduğumuz sonuçlarda pH, laktat ve klorür değerlerinde doğruluk oranları başarılı bir şekilde sağlanmıştır. Glikoz değerleri ile ilgili kesin sonuç alınamamakla beraber varlığı ispat edilmiştir. Sonuç olarak çalışmamızda bireylerin kişisel vücut parametrelerini ter ile öğrenebilecekleri ve bu öğrendikleri değerleri kayıt altına alabilecekleri bir sistem gerçekleştirilmiştir. Geliştirmesine devam ettiğimiz sistemimiz ile mevcut sistemler arasında, saydığımız parametreler ve bunlara bağlı enfeksiyon durumlarını ölçen tanı cihazlarının yerini alabilecek, hem mevcut sistemlerden daha hızlı ölçüm yapabilen hem de daha düşük bir maliyet ile birçok tanı kiti üretiminin yolunu açmış olacağız.

Anahtar Kelimeler: Yapay zeka, Laktak, pH, Akıllı Bant

GLUCOSE, pH, LACTATE, CHLORIDE ANALYSIS IN HUMAN SWEAT IS DONE WITH A SAMRT BAND ADHERED TO THE SKIN

ABSTRACT

In this study, various studies have been carried out to measure the pH, lactate, chloride, glucose substances of sweat with the analyzes made on samples taken from human sweat. In this research, primarily work on reagents was carried out and then the indicators were developed. An artificial intelligence-supported interface has been created and programmed to measure the changes made by these indicators with sweat. It is aimed to make a useful, portable kit with the reagents integrated into our main material, which we designed by building micron channels in its structure. The working principle of this system is that the sweat samples that enter the device after the user glues the kit on the skin combine with the reagents and react and the changes are transferred to the phone via a phone camera. Our smartphone-supported application that we have made gives us information about the content of sweat by comparing the values previously referenced with the uv-spectrophotometer.
After the reagents we prepared for use in our studies reacted with sweat, the accuracy rates in pH, lactate and chloride values were successfully achieved in our results. Although there is no definite conclusion about glucose values, its existence has been proved. As a result, in our study, a system was developed in which individuals can learn their personal body parameters with sweat and record these values. Between our system we continue to develop and existing systems, we will be able to replace the diagnostic devices that measure the parameters we count and the infection states associated with them, and will have opened the way for the production of many diagnostic kits that can both measure faster than the existing systems and at a lower cost.

Keywords: Artificial Intelligance, Lactate, pH, Smart Band

EKSTRÜZYON PİŞİRME YÖNTEMİ İLE SİYEZ UNU KULLANILARAK TÜKETİME HAZIR ERİŞTE ÜRETİMİ

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ÖZET

Şehirleşmenin artması, kadınların çalışma hayatında daha aktif rol almaları ve yoğun çalışma saatleri ve zamansızlık sebebiyle tüketiciler hazır gıdalara yönelmektedir. Bu hazır gıdalar arasında olan tüketime hazır erişte, makul fiyat, pişirme kolaylığı ve tüketicilere hoş gelen tatları nedeniyle dünya çapında çok popülerdir ve tüketimi günden güne artmaktadır. Tüketime hazır erişteler genellikle yüksek karbonhidrat ve yağ içeriğiyle birlikte düşük protein ve lif oranına sahiptir. Tüketiciler tarafından, lif ve protein bakımından zengin ve düşük yağ içeriğine sahip diyetlere yönelim arttığından daha yüksek protein, daha iyi kalitede ve daha ucuz olan yeni nesil erişteler için yeni formül arayışına girilmiştir. Bu çalışmada buğday unu yerine siyez unu kullanılarak farklı formülasyon ve ekstrüzyon parametreleriyle tüketime hazır erişte üretimi amaçlanmıştır. Sıcak ekstrüzyon tekniği ile üretilip pişirilen erişteler sıcak hava ile kurutma işlemine tabi tutulmuştur. Eş yönlü dönen çift vidalı ekstrüder kullanılarak karıştırma, yoğurma, şekil verme ve pişirme işlemi tek bir proseste gerçekleştirilmiştir. Hazırlanan hammadde karışımları ekstrüdere beslenmeden önce bir ön ısıtma (ön şartlandırma) işlemi uygulanmıştır. Ön şartlandırma işlemi, içinde dönen çarklar bulunan bir ısı ceketli ön şartlandırıcıda 65 ^{o}C' de gerçekleştirilmiştir. Sabit besleme hızı ve besleme neminde hammadde formülasyonunda %10, 20 ve 30 patates nişastası kullanılarak, kovan sıcaklığı 80, 90 ve 100 ^{o}C ve vida hızı ise 100, 110 ve 120 dev/dak olacak şekilde erişte üretimi gerçekleştirilmiştir. Üretilen erişlerin nem, kül, yağ ve protein değerleri ile pişme özellikleri belirlenmiştir. Sonuç olarak bu çalışma, siyez unu kullanılarak piyasadaki kızarmış erişlerden daha düşük yağ içeriğine sahip ve alternatif olarak tüketilebilecek farklı bir hazır erişte ürünü üretiminin mümkün olabileceğini göstermektedir.

Anahtar Kelimeler: Hazır Erişte, Ekstrüzyon, Siyez Unu, Ekstrüder

PRODUCTION OF INSTANT NOODLE BY USING EINKORN WHEAT FLOUR WITH EXTRUSION COOKING METHOD

ABSTRACT

Due to the increase in urbanization, women's more active role in working life, and busy working hours and timelessness, consumers turn to ready-made foods. Instant noodles, which are among these ready-to-eat foods, are very popular around the world due to their reasonable price, convenience of cooking and taste that is pleasant to consumers, and their consumption is increasing day by day. Instant noodles usually have high carbohydrate and fat content, and low protein and fiber content. As consumers are increasingly turning to diets that are rich in fiber and protein and have low fat content, new formulas for higher quality and cheaper new generation noodles with higher protein content are being sought. In this study, it is aimed to produce instant noodles with different formulation and extrusion parameters using einkorn wheat flour instead of wheat flour. Noodles produced and cooked by hot extrusion technique were subjected to hot air drying. Mixing, kneading, shaping and cooking were performed in a single process using a co-rotating twin screw extruder. A preheating process was applied to the prepared raw material mixes before being fed to the extruder. The preconditioning process was carried out at 65 ^{o}C in a heat jacket preconditioner with rotating impellers. Noodles were produced using 10, 20 and 30% potato starch in the raw material formulation at constant feed rate and feed moisture, with the barrel temperature of 80, 90 and 100 ^{o}C and screw speed of 100, 110 and 120 rpm. Moisture, ash, oil and protein contents and cooking properties of noodles were determined. As a result, this study shows that it is possible to produce a different instant noodle product that can be consumed alternatively with a lower fat content than fried noodles in the market using einkorn wheat flour.

Keywords: Instant noodle, Extrusion, Einkorn Wheat Flour, Extruder

TARIMSAL İŞLETMELERİN BÜYÜTÜLMESİNDE ARAZİ BANKACILIĞI

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ÖZET

İnsanoğlu dünden bugüne araziyi, barınma ve yaşam alanı dışında, hızla artış gösteren nüfusun beslenmesi için gıda üretim alanı olarak kullanmıştır. Gıda üretimi ise ihtiyaçlar ve önceliklere göre değişim göstermektedir. Değişim göstermeyen tek konu, bu arazilerden en yüksek düzeyde verim almak için yapılan çalışmalardır. Farklı sektörlerin arazi ihtiyaçlarının bir kısmını tarım arazilerinden karşılamaları, var olan arazilerin verimli kullanılması için arazi yönetimi ihtiyacını ortaya koymuştur. Arazi yönetiminin en uygun şekilde kullanımı da arazi bankacılığı sistemi ile olacağı düşünülmektedir. Türkiye'de özellikle küçük aile işletmelerinin yoğunluğu ve işletme arazilerinin parçalılığı, kaynakların verimli kullanımını engelleyerek, teknoloji kullanımını da zorlaştırmaktadır. Bu durum gıda güvenliğini tehdit etmektedir. Bu sebeple arazilerin yönetiminde etkin rol alacak yeni bir yapının gerekliliği yadsınamaz. Ülkemizde, küçük, parçalanmış ve dağınık yapıda olan tarım arazilerini ve işletmelerini yönetebilmek için, arazi alım satımını belirli kurallara bağlayacak ve arazi piyasasını izleyecek arazi bankacılığı gibi bir kuruma ihtiyaç söz konusudur. Bu çalışmada da arazi yönetiminde etkili olacağı düşünülen bu sistemin ele alınması amaçlanmıştır. Çalışmada ele alınan sistemin yani arazi bankacılığının kapsamlı tanımı, arazi bankacılığının kurulmasının temel aşamaları, ülkemizde arazi bankacılığı ihtiyacı ve dünyada arazi bankacılığı sistemini uygulayan Fransa, Almanya, İspanya, Macaristan, Belçika, Danimarka, Ukrayna gibi ülkelerin sistemleri ele alınarak örneklerle incelenmiştir.

Anahtar kelimeler: Arazi yönetimi, Arazi bankacılığı, Arazi verimliliği

LAND BANKING IN THE GROWTH OF AGRICULTURAL ENTERPRISES

ABSTRACT

Between the past and future and in the present, humans have used the land as a food production area to facing the rapidly increasing population problem and use it as a shelter and living space. Food production changes according to the needs and priorities of humans. To reach the maximum level of production from these lands were studied by not changeable subject in this research. The fact that different sectors meet some of their land needs from agricultural lands has revealed the need for land management for efficient use of existing areas. It is thought that the most appropriate method of land management will be with the land banking system. Turkey is living the problem of fragmentation of businesses, especially in small family businesses; therefore, that's preventing reaching the most efficient use of

resources, also it makes it difficult to use the technology. This situation threatens food safety.For this reason, it is necessary to build a new structure that will be able to activate the role of land management in turkey. In our country, in order to manage small, fragmented and scattered agricultural lands and businesses, there is a need for an institution such as land banking, which will regulate the buying and selling of land and monitor the land market. In this study, it is aimed to address this system, which is thought to be effective in land management. The comprehensive definition of the system, namely land banking, the primary stages of the establishment of land banking, the needs of land banking in our country and the policies of countries such as France, Germany, Spain, Hungary, Belgium, Denmark, and Ukraine, which are implementing the land banking system in the world, are examined with examples.

Keywords: Land management, Land banking, Land productivity

KISITLAMASIZ JACOBSTHAL VE JACOBSTHAL – LUCAS HİBRİT SAYILARI

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ÖZET

Bu çalışmada katsayıları keyfi Jacobsthal ve Jacobsthal – Lucas sayıları olan hibrit sayılar incelenmiştir. Katsayıların keyfi olması sebebiyle bu sayılar kısıtlamasız Jacobsthal ve Jacobsthal – Lucas hibrit sayıları olarak isimlendirilmiştir. Bu hibrit sayılar için üreteç fonksiyonları ve Binet formülleri hesaplandıktan sonra, Vajda, Catalan, Cassini, d'Ocagne gibi bazı bilinen özdeşlikler elde edilmiştir.

Anahtar Kelimeler: Jacobsthal sayıları, Jacobsthal – Lucas sayıları, hibrit sayılar

UNRESTRICTED JACOBSTHAL AND JACOBSTHAL – LUCAS HYBRID NUMBERS

ABSTRACT

In this study, the hybrid numbers whose coefficients are arbitrary Jacobsthal and Jacobsthal – Lucas numbers. Due to this arbitrariness, these numbers are called unrestricted Jaconsthal and Jacobsthal – Lucas hybrid numbers. After calculating generating functions and Binet formulas for these hybrid numbers, we give some well – known identities for these numbers such as Vajda's, Catalan's, Cassini's and d'Ocagne's identities.

Keywords: Jacobsthal numbers, Jacobsthal – Lucas numbers, hybrid numbers

1. INTRODUCTION

Jacobsthal (OEIS: sequence A001045, [8]) and Jacobsthal – Lucas (OEIS: sequence A014551, [8]) numbers form two well – known sequences among integer sequences which satisfy second order recurrence relations. Jacobsthal numbers satisfy the recurrence relation

$$J_0 = 0, J_1 = 1,\ J_n = J_{n-1} + 2J_{n-2} \ \ (\text{for } n \geq 2). \tag{1}$$

Similarly, Jacobsthal – Lucas numbers satisfy the recurrence relation

$$j_0 = 2, j_1 = 1,\ j_n = j_{n-1} + 2j_{n-2} \ \ (\text{for } n \geq 2). \tag{2}$$

The generating functions for the Jacobsthal sequence $\{J_n\}_{n=0}^{\infty}$ and Jacobsthal – Lucas sequence $\{j_n\}_{n=0}^{\infty}$ are

$$\sum_{n=0}^{\infty} J_n x^n = \frac{x}{1-x-2x^2} \tag{3}$$

and

$$\sum_{n=0}^{\infty} j_n x^n = \frac{2-x}{1-x-2x^2} \tag{4}$$

respectively. The Binet formulas for the Jacobsthal and Jacobsthal – Lucas numbers are

$$J_n = \frac{2^n-(-1)^n}{3} \tag{5}$$

and

$$j_n = 2^n+(-1)^n \tag{6}$$

respectively. Whereas the first Jacobsthal numbers are: 0, 1, 1, 3, 5, 11, 21, 43, 85, 171, 341,…, the first Jacobsthal – Lucas numbers are 2, 1, 5, 7, 17, 31, 65, 127, 257, 511,…

Hybrid numbers are introduced by Ozdemir [9] as a mixture of Real numbers, Complex numbers, Dual numbers and Hyperbolic numbers. The set of all hybrid nymbers is

$$\mathrm{K} := \left\{a+bi+c\varepsilon+dh : a,b,c,d \in \mathbb{R}, i^2=-1, \varepsilon^2=0, h^2=1, ih=-hi=\varepsilon+i\right\}.$$

The multiplication rules for the elements of the basis $\{1,i,\varepsilon,h\}$ can be found in the following table.

Table 1. Multiplication rules for the set $\{1,i,\varepsilon,h\}$

.	1	i	ε	h
1	1	i	ε	h
i	i	-1	$1-h$	$\varepsilon+i$
ε	ε	$h-1$	0	$-\varepsilon$
h	h	$-\varepsilon-i$	ε	1

Let k_1 and k_2 are two hybrid numbers, i.e. $k_1 = a_1+b_1i+c_1\varepsilon+d_1h$ and $k_2 = a_2+b_2i+c_2\varepsilon+d_2h$. Then addition of two hybrid numbers is

$$k_1+k_2 = a_1+a_2+(b_1+b_2)i+(c_1+c_2)\varepsilon+(d_1+d_2)h$$

and by using Table 1, we obtain multiplication of two hybrid numbers as

$$k_1k_2 = a_1a_2 - b_1b_2 + b_1c_2 + b_2c_1 + d_1d_2 + (a_1b_2 + a_2b_1 + b_1d_2 - b_2d_1)i$$
$$+ (a_1c_2 + a_2c_1 + b_1d_2 - b_2d_1 - c_1d_2 + c_2d_1)\varepsilon + (a_1d_2 + a_2d_1 - b_1c_2 + b_2c_1)h.$$

The conjugate of a hybrid number $k = a + bi + c\varepsilon + dh$ is

$$\bar{k} = a - bi - c\varepsilon - dh,$$

the character of k is

$$c(k) = k\bar{k} = \bar{k}k = a^2 + (b-c)^2 - c^2 - d^2$$

and the norm of k is

$$N(k) = \sqrt{|c(k)|} = \sqrt{|a^2 + (b-c)^2 - c^2 - d^2|}\ .$$

For other properties of the hybrid numbers, see [8]. There are many studies about hyper-complex numbers whose coefficients are Jacobsthal and Jacobsthal – Lucas numbers. Some authors studied on Jacobsthal quaternions [1, 2, 6, 11, 14, 15], Jacobsthal octonions [4, 7], Jacobsthal sedenions [5], whereas some authors studied on the hybrid numbers whose coefficients are some well – known integer sequences such as Horadam hybrid numbers [10], Jacobsthal hybrid numbers [12], k–Pell hybrid numbers [3] and Pell Hybrid numbers [12].

In all these studies, authors chose the coefficients of ordered basis of hyper-complex algebra as successive elements of an integer sequences. The difference between these studies and current study is that we pick arbitrary Jacobsthal and Jacobsthal – Lucas numbers as coefficients of the basis $\{1, i, \varepsilon, h\}$ of hybrid numbers.

2. DEFINITIONS, GENERATING FUNCTIONS AND BINET FORMULAS

We give the definitions of unrestricted Jacobsthal and Jacobsthal – Lucas hybrid numbers at first.

Definition 1. For any integers p, r, s and non – negative integer n, n th unrestricted Jacobsthal and Jacobsthal – Lucas hybrid numbers are

$$J_n^{(p,r,s)} = J_n + J_{n+p}i + J_{n+r}\varepsilon + J_{n+s}h \tag{7}$$

and

$$j_n^{(p,r,s)} = j_n + j_{n+p}i + j_{n+r}\varepsilon + j_{n+s}h \tag{8}$$

where J_m and j_m are the m th Jacobsthal and Jacobsthal – Lucas numbers respectively.

The identities $J_{-n}=\frac{(-1)^{n+1}}{2^n}J_n$ and $j_{-n}=\frac{(-1)^n}{2^n}j_n$ lead us to the following terms with negative indices

$$J_{-n}^{(p,r,s)}=\frac{(-1)^{n+1}}{2^n}\left[J_n+(-1)^p 2^p J_{n-p}i+(-1)^r 2^r J_{n-r}\varepsilon+(-1)^s 2^s J_{n-s}h\right] \tag{9}$$

and

$$j_{-n}^{(p,r,s)}=\frac{(-1)^n}{2^n}\left[j_n+(-1)^p 2^p j_{n-p}i+(-1)^r 2^r j_{n-r}\varepsilon+(-1)^s 2^s j_{n-s}h\right]. \tag{10}$$

The recurrence equations (1) and (2) give the following equations

$$J_n^{(p,r,s)}=J_{n-1}^{(p,r,s)}+2J_{n-2}^{(p,r,s)} \tag{11}$$

and

$$j_n^{(p,r,s)}=j_{n-1}^{(p,r,s)}+2j_{n-2}^{(p,r,s)}. \tag{12}$$

The generating functions for the sequences of unrestricted Jacobsthal and Jacobsthal – Lucas hybrid numbers is given in the following theorem.

Theorem 2. The generating functions for the sequences $\left\{J_n^{(p,r,s)}\right\}_{n=0}^{\infty}$ and $\left\{j_n^{(p,r,s)}\right\}_{n=0}^{\infty}$ are

$$J(x)=\frac{J_0^{(p,r,s)}+x\left(J_1^{(p,r,s)}-J_0^{(p,r,s)}\right)}{1-x-2x^2} \tag{13}$$

and

$$j(x)=\frac{j_0^{(p,r,s)}+x\left(j_1^{(p,r,s)}-j_0^{(p,r,s)}\right)}{1-x-2x^2} \tag{14}$$

respectively.

Proof. Let's define $J(x)=\sum_{n=0}^{\infty}J_n^{(p,r,s)}x^n$. Then we have

$$J(x)=J_0^{(p,r,s)}+xJ_1^{(p,r,s)}+\sum_{n=2}^{\infty}J_n^{(p,r,s)}x^n. \tag{15}$$

If we multiply Eq.(13) by $-x$ and $-2x^2$, we obtain

$$-xJ(x)=-xJ_0^{(p,r,s)}-\sum_{n=2}^{\infty}J_{n-1}^{(p,r,s)}x^{n-1} \tag{16}$$

$$-2x^2J(x)=-2\sum_{n=2}^{\infty}J_{n-2}^{(p,r,s)}x^{n-2} \tag{17}$$

respectively. If we add Eqs.(15), (16) and (17), we get

$$(1-x-x^2)J(x)=J_0^{(p,r,s)}+x\left(J_1^{(p,r,s)}-J_0^{(p,r,s)}\right)+\sum_{n=2}^{\infty}\left(J_n^{(p,r,s)}-J_{n-1}^{(p,r,s)}-2J_{n-2}^{(p,r,s)}\right)x^n.$$

Eq.(11) gives $J_n^{(p,r,s)}-J_{n-1}^{(p,r,s)}-2J_{n-2}^{(p,r,s)}=0$, then we obtain Eq.(13). The other generating function can be obtained in a similar way. □

The Biner formulas for the unrestricted Jacobsthal and Jacobsthal – Lucas hybrid numbers are given in the following theorem.

Theorem 3. For any integers n, p, r and s, the nth unrestricted Jacobsthal and Jacobsthal – Lucas hybrid numbers are

$$J_n^{(p,r,s)}=\frac{A2^n-B(-1)^n}{3} \tag{18}$$

and

$$j_n^{(p,r,s)}=A2^n+B(-1)^n \tag{19}$$

respectively, where $A=1+2^pi+2^r\varepsilon+2^sh$ and $B=1+(-1)^pi+(-1)^r\varepsilon+(-1)^sh$.

Proof. The Binet formula for the Jacobsthal numbers (5) and definition (7) give

$$J_n^{(p,r,s)}=J_n+J_{n+p}i+J_{n+r}\varepsilon+J_{n+s}h$$

$$=\frac{1}{3}\left[2^n-(-1)^n+\left(2^{n+p}-(-1)^{n+p}\right)i+\left(2^{n+r}-(-1)^{n+r}\right)\varepsilon+\left(2^{n+s}-(-1)^{n+s}\right)h\right]$$

$$=\frac{1}{3}\left[2^n\left(1+2^pi+2^r\varepsilon+2^sh\right)-(-1)^n\left(1+(-1)^pi+(-1)^r\varepsilon+(-1)^sh\right)\right].$$

The last equation gives Eq.(18). Eq.(19) can be obtained similarly. □

We need the following identities to calculate properties of the unrestricted Jacobsthal and Jacobsthal – Lucas hybrid numbers.

Lemma 4. We have

$$AB = \omega + 3\psi \tag{20}$$

and

$$BA = \omega - 3\psi \tag{21}$$

where

$$\omega = j_0^{(p,r,s)} - 1 - (-2)^p + (-1)^s + (-2)^r j_{p-r} \tag{22}$$

and

$$\psi = i(-2)^s J_{p-s} + \varepsilon\left[(-2)^s J_{p-s} + (-2)^r J_{s-r}\right] + h(-2)^p J_{r-p}. \tag{23}$$

Proof. We have

$$AB = \left(1 + 2^p i + 2^r \varepsilon + 2^s h\right)\left(1 + (-1)^p i + (-1)^r \varepsilon + (-1)^s h\right)$$

$$= 1 - 2^p(-1)^p + 2^s(-1)^s + 2^p(-1)^r + 2^r(-1)^p + i\left[2^p + (-1)^p + 2^p(-1)^s - 2^s(-1)^p\right]$$

$$+\varepsilon\left[2^r + (-1)^r + 2^p(-1)^s - 2^s(-1)^p + 2^s(-1)^r - 2^r(-1)^s\right]$$

$$+h\left[2^s + (-1)^s + 2^r(-1)^p - 2^p(-1)^r\right]$$

$$= 1 - 2^p(-1)^p + 2^s(-1)^s + 2^p(-1)^r + 2^r(-1)^p + ij_p + \varepsilon j_r + hj_s + 3(-2)^s i\left[\frac{2^{p-s} - (-1)^{p-s}}{3}\right]$$

$$+3\varepsilon\left[(-2)^s \frac{2^{p-s} - (-1)^{p-s}}{3} + (-2)^r \frac{2^{s-r} - (-1)^{s-r}}{3}\right] + 3(-2)^p\left[\frac{2^{r-p} - (-1)^{r-p}}{3}\right]$$

$$= j_0^{(p,r,s)} - 1 - (-2)^p + (-2)^s + (-2)^r\left[2^{p-r} + (-1)^{p-r}\right] + 3(-2)^s J_{p-s} i$$

$$+3\left[(-2)^s J_{p-s} + (-2)^r J_{s-r}\right]\varepsilon + 3(-2)^p J_{r-p} h.$$

The last equation gives Eq.(20). The other equation can be calculated similarly. □

3. RESULTS

In this section, we give some identities which generalize well – known identities. First, We start with Vajda's identities.

Theorem 5. (Vajda's identity). For any integers m, n, k, p, r and s, we have

$$J_{m+n}^{(p,r,s)} J_{m+k}^{(p,r,s)} - J_m^{(p,r,s)} J_{m+n+k}^{(p,r,s)} = (-2)^m J_n \left(\omega J_k - \psi j_k\right) \tag{24}$$

and

$$j_{m+n}^{(p,r,s)} j_{m+k}^{(p,r,s)} - j_m^{(p,r,s)} j_{m+n+k}^{(p,r,s)} = -9(-2)^m J_n \left(\omega J_k - \psi j_k\right). \tag{25}$$

Proof. From the Binet formula (15), we obtain

$$J_{m+n}^{(p,r,s)} J_{m+k}^{(p,r,s)} - J_m^{(p,r,s)} J_{m+n+k}^{(p,r,s)}$$

$$= \frac{1}{9}\left[\left(A2^{m+n} - B(-1)^{m+n}\right)\left(A2^{m+k} - B(-1)^{m+k}\right) - \left(A2^m - B(-1)^m\right)\left(A2^{m+n+k} - B(-1)^{m+n+k}\right)\right]$$

$$= \frac{1}{9}\left[-AB2^{m+n}(-1)^{m+k} - BA2^{m+k}(-1)^{m+n} + AB2^m(-1)^{m+n+k} + BA2^{m+n+k}(-1)^m\right]$$

$$= \frac{(-2)^m}{9}\left[-AB2^n(-1)^k - BA2^k(-1)^n + AB(-1)^{n+k} + BA2^{n+k}\right]$$

$$= \frac{(-2)^m}{9}\left[-(\omega+3\psi)2^n(-1)^k - (\omega-3\psi)2^k(-1)^n + (\omega+3\psi)(-1)^{n+k} + (\omega-3\psi)2^{n+k}\right]$$

$$= \frac{(-2)^m}{9}\left[-(-1)^k(\omega+3\psi)\left(2^n - (-1)^n\right) + (2)^k(\omega-3\psi)\left(2^n - (-1)^n\right)\right]$$

$$= \frac{(-2)^m}{3}\left[(-1)^{k+1}(\omega+3\psi)J_n + 2^k(\omega-3\psi)J_n\right]$$

$$= \frac{(-2)^m J_n}{3}\left[\omega\left(2^k - (-1)^k\right) - 3\psi\left(2^k + (-1)^k\right)\right]$$

$$= (-2)^m J_n \left(\omega J_k - \psi j_k\right).$$

The last equation is Eq.(24). Eq.(25) can be obtained in a similar way. □

The most important result of Vajda's identity is Catalan's identity. If we substitute $k \to -n$ into the Vajda's identities with the identities $J_n J_{-n} = \frac{(-1)^{n+1}}{2^n} J_n^2$ and $J_n j_{-n} = \frac{(-1)^n}{2^n} J_{2n}$, we obtain the Catalan's identities which are given in the following.

Theorem 6. (Catalan's identity) For any integers m, n, p, r and s, we have

$$J_{m+n}^{(p,r,s)} J_{m-n}^{(p,r,s)} - \left[J_m^{(p,r,s)} \right]^2 = (-1)^{m+n+1} 2^{m-n} \left[\omega J_n^2 + \psi J_{2n} \right] \tag{26}$$

and

$$j_{m+n}^{(p,r,s)} j_{m-n}^{(p,r,s)} - \left[j_m^{(p,r,s)} \right]^2 = 9(-1)^{m+n} 2^{m-n} \left[\omega J_n^2 + \psi J_{2n} \right]. \tag{27}$$

If we substitute $n \to 1$ into Catalan's identities, we get Cassini's identities given in the following theorem.

Theorem 7. (Cassini's identity). For any integers m, p, r and $s,$ we have

$$J_{m+1}^{(p,r,s)} J_{m-1}^{(p,r,s)} - \left[J_m^{(p,r,s)} \right]^2 = (-1)^m 2^{m-1} \left[\omega + \psi \right] \tag{28}$$

and

$$j_{m+1}^{(p,r,s)} j_{m-1}^{(p,r,s)} - \left[j_m^{(p,r,s)} \right]^2 = 9(-1)^{m+1} 2^{m-1} \left[\omega + \psi \right]. \tag{29}$$

Another well – known identity is d'Ocagne's identity given in the following theorem.

Theorem 8. (d'Ocagne's identity) For any integers m, n, p, r and $s,$ we have

$$J_m^{(p,r,s)} J_{n+1}^{(p,r,s)} - J_{m+1}^{(p,r,s)} J_n^{(p,r,s)} = (-2)^n \left[\omega J_{m-n} + \psi j_{m-n} \right] \tag{30}$$

and

$$j_m^{(p,r,s)} j_{n+1}^{(p,r,s)} - j_{m+1}^{(p,r,s)} j_n^{(p,r,s)} = -9(-2)^n \left[\omega J_{m-n} + \psi j_{m-n} \right]. \tag{31}$$

Proof. From the Binet formulas for the unrestricted Jacobsthal hybrid numbers, we have

$$J_m^{(p,r,s)} J_{n+1}^{(p,r,s)} - J_{m+1}^{(p,r,s)} J_n^{(p,r,s)}$$

$$= \frac{1}{9} \left[\left(A2^m - B(-1)^m \right) \left(A2^{n+1} - B(-1)^{n+1} \right) - \left(A2^{m+1} - B(-1)^{m+1} \right) \left(A2^n - B(-1)^n \right) \right]$$

$$= \frac{1}{9} \left[-AB2^m (-1)^{n+1} - BA2^{n+1} (-1)^m + AB2^{m+1} (-1)^n + BA2^n (-1)^{m+1} \right]$$

$$= \frac{(-2)^n}{3} \left[AB2^{m-n} - BA(-1)^{m-n} \right]$$

$$= \frac{(-2)^n}{3}\left[(\omega+3\psi)2^{m-n} - (\omega-3\psi)(-1)^{m-n}\right]$$

$$= \frac{(-2)^n}{3}\left[\omega\left(2^{m-n} - (-1)^{m-n}\right) + 3\psi\left(2^{m-n} + (-1)^{m-n}\right)\right].$$

The last equation with Eqs. (5) and (6) gives the Eq. (30) in the theorem. Eq. (31) can be calculated similarly. □

By using recurrence relations, Binet formulas and known identities for Jacobsthal and Jacobsthal numbers, we can obtain some basic relations which are given in the following theorem.

Theorem 9. For any integers m, n, k, p, r and s, we have

$$j_n^{(p,r,s)} = J_{n+1}^{(p,r,s)} + 2J_{n-1}^{(p,r,s)},$$

$$9J_n^{(p,r,s)} = j_{n+1}^{(p,r,s)} + 2j_{n-1}^{(p,r,s)},$$

$$j_{n+1}^{(p,r,s)} + j_n^{(p,r,s)} = 3.2^n\left(1 + i2^p + \varepsilon 2^r + h2^s\right),$$

$$3J_{n+1}^{(p,r,s)} + j_n^{(p,r,s)} = 2^{n+1}\left(1 + i2^p + \varepsilon 2^r + h2^s\right),$$

$$J_n^{(p,r,s)} + j_n^{(p,r,s)} = 2J_{n+1}^{(p,r,s)},$$

$$\sum_{i=2}^{n} J_i^{(p,r,s)} = \frac{1}{2}\left(J_{n+2}^{(p,r,s)} - 3\right),$$

$$\sum_{i=2}^{n} j_i^{(p,r,s)} = \frac{1}{2}\left(j_{n+2}^{(p,r,s)} - 5\right).$$

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OPTIMIZATIONN OF VESSEL CRANE ALLOCATION POLICIES FOR A CONTAINER TERMINAL MANAGEMENT

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ABSTRACT

The vessel-crane allocation problem in seaports influence the vessel handling and overall seaport handling capacity. In the study, we proposed an event-based simulation model for simulating the vessel berthing operations and crane allocation strategies for a peninsula type container terminal with three continuous berths. Several mobile harbor crane allocation policies were subject to an optimization study using the Scatter Search Algorithm (SSA). By using an optimized policy vector ($\vec{V}$) for defining the weekly selected allocation policy, total numbers of the annual handled containers were increased from 561.650 to 673.980 (total 112.330 handled containers). The study result indicated that optimization of the crane allocation policies for a container terminal have a great influence on the total handling capacity and results a 20% capacity increase. From the results of the study, it can be concluded that the application of a dynamic crane allocation policies for berths can increase the total handled containers and efficiency at seaports.

Keywords: Optimization, crane, container terminal, seaport, simulation.

1. Introduction

Seaports are one of the important factors of a countries trade and container terminals at ports play a crucial role in global trade. The throughput capacity of a seaport is a vital contributor to its competitiveness among the rival seaports (Ilati et al., 2014). The handling performance of a seaport is directly influenced by the berth utilization, design of the facility and also the handling capacity of the equipment. Apart from the characteristics, berth allocation problem and crane allocation policy also affects the seaport performance. In a conventional seaport, berths are planned to serve the vessels where the quay cranes are assigned for vessels for handling. For an efficient seaport operation, both the berths and quay cranes should be utilized with a higher percentage.

In the literature, crane allocation problem is touched by many researchers. Daganzo (1989) firstly presented the exact and approximate solutions for the crane scheduling based on the optimality principles and limited berthing length. Through the years new integrated approaches were developed by the researchers (Bierwirth and Meisel, 2010). In their study, Meisel and Bierwirth (2006) proposed a heuristic method for integrated solution of the berth allocation and crane assignment problems They also provided the computational results for a real life seaport. In another study, Na ad Zhihong (2009) addressed a joint continuous berth

optimization and quay crane allocation problem in a container terminal by considering the avoidance of crane crossover and proposed a heuristic method for achieving the optimal solution. Liu et al. (2006) proposed a mixed integer linear programming model for quay crane scheduling and heuristic decomposition method to minimize the maximum relative delay of vessel departures. In another study, Jiao et al. (2018) focused on the integrated continuous berth allocation and time-variant crane scheduling problem in a container terminals considering the impact of tides in a approach channel. Numerical experiments were reported for demonstrating the performances of swarm-based heuristics.

There are some studies in literature about model development and simulation studies for different problems at seaports. It was seen from the previous studies that there are various model developments by the researchers for the seaport optimization such as resource constrained project scheduling problem, MIP model, multi-objective resource allocation theory, mathematical model, simulation optimization approach and simulation based optimization (Zeng et al., 2011;Imai et al., 2008; Meisel and Bierwirth, 2006; Liang et al., 2011). The berth allocation problem (BAP) is one of the most important problem at seaports. Researchers, decision makers and operators at seaports mainly aim to minimize the total service time for all ships by fixing the berth allocation problem by using different algorithms. For example in their study, Lai and Shih (1992) suggested a heuristic algorithm to solve BAP problems via simulation experiments. In a different study, Imai et al. (2007) investigated the BAP by simulating and they suggested an integer linear programming model for the problem solution. Imai et al. (2001) also examined the static BAP by using simulation model. In a similar study, Lee and Chen (2009) developed and suggested a candidate-based approach to handle BAP by allowing vessel shifting by evaluating clearance distance between vessels. Simulation methods are effectively used by the researchers to model planning and management system of the seaports (Tahar and Hussain, 2013). For example, Kotachi et al. (2013) used a simulation method for analyzing multimodality in seaports as a case study. In a different study, Tahar and Hussain (2013) used simulation methods to investigate the berthing schedule at seaports. In a comprehensive study, Park and Dragovic (2009) also used simulation applications to investigate and model queues and bottlenecks, container handling, internal transporter, ship schedules, container yard utilization at seaports. In a similar study, Pujawan et al. (2015) used simulation techniques to combine the decisions to storage capacity under uncertain demand situation.

In literature, many studies addressed the crane allocation and scheduling issue integrated with metaheuristics, optimization techniques and simulation approaches. Apart from the recent literature, this study demonstrated a novel allocation strategy for mobile harbor crane utilization in container terminals and presented a case study for the applicability of the crane allocation strategy using an even-based simulation model.

2. Model Development and Simulation

In the scope of the study, an Event-driven Micro-Simulation model (Ed-MSIM) was developed for simulating the berthing and vessel operations with discrete phases of different

crane assignment policies. The model was developed by using the Discrete Event Based (DEB) Arena® simulation software. For this purpose, different discrete event modelling blocks and paradigms were also used in the simulation software. For the ease of the model development and design, the model structure was divided into the four separate modelling modules as a)Vessel generation, b)Berthing queuing, c)Vessel operation and d)Crane allocation. The model is specifically based on the container vessels and can also be configured for bulk cargo vessels and etc. The vessels are generated using a predetermined arriving schedules by using the CREATE blocks and vessel characteristics attributes are also assigned for each generated vessel using the ASSIGN block. For each vessel, several vessel attributes are assigned as vessel length, length class, container load and arrival time stamp for the performance measurement. The vessel generation and assignment blocks of the Arena module are shown in Figure 1.

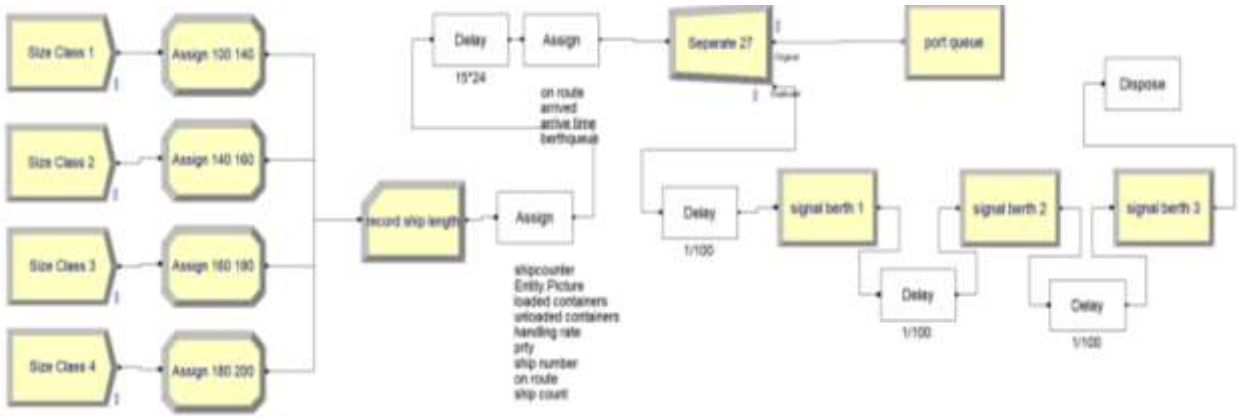

Figure 1. Arena vessel generation and assignment blocks.

In the study developed model also simulates the vessel berthing with FCFS (First come, First serve) allocation rule and a single vessel berthing queue. The arriving vessel tries to allocate a suitable berth and if there is no available berth, it takes the first rank in the queue and waits for the end of the berthed vessel operation. After the operation of any bathed vessel finished, the berthing queue is touched and the first waiting vessel is taken to the available berth. The simulation model also utilizes several construct block of the Arena software for simulating the vessel operations. The DELAY block is specifically used for the representing the dwell time of the vessel operation. The view of the Arena blocks simulating the berthing operations are shown in Figure 2.

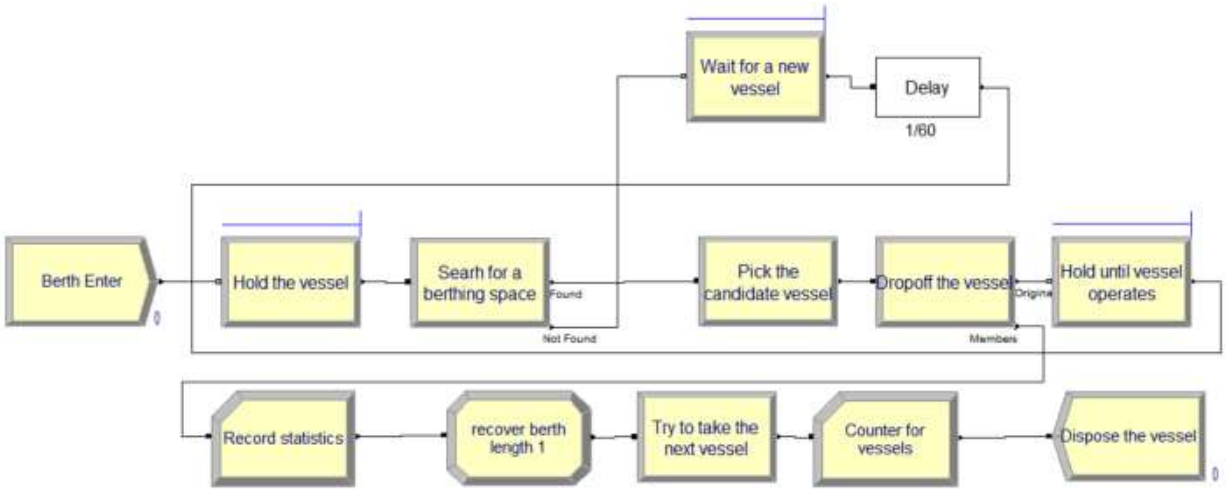

Figure 2. Arena vessel berthing and operations blocks.

In the study, a peninsula type berth structure was investigated with three continuous berthing places oriented as a rectangular layout for a container terminal. The hypothetical container terminal is placed at the middle of the seaport functional area and there is available space for the mobility of the mobile harbor cranes between each berth. The schematic view of the seaport layout is given in Figure 3.

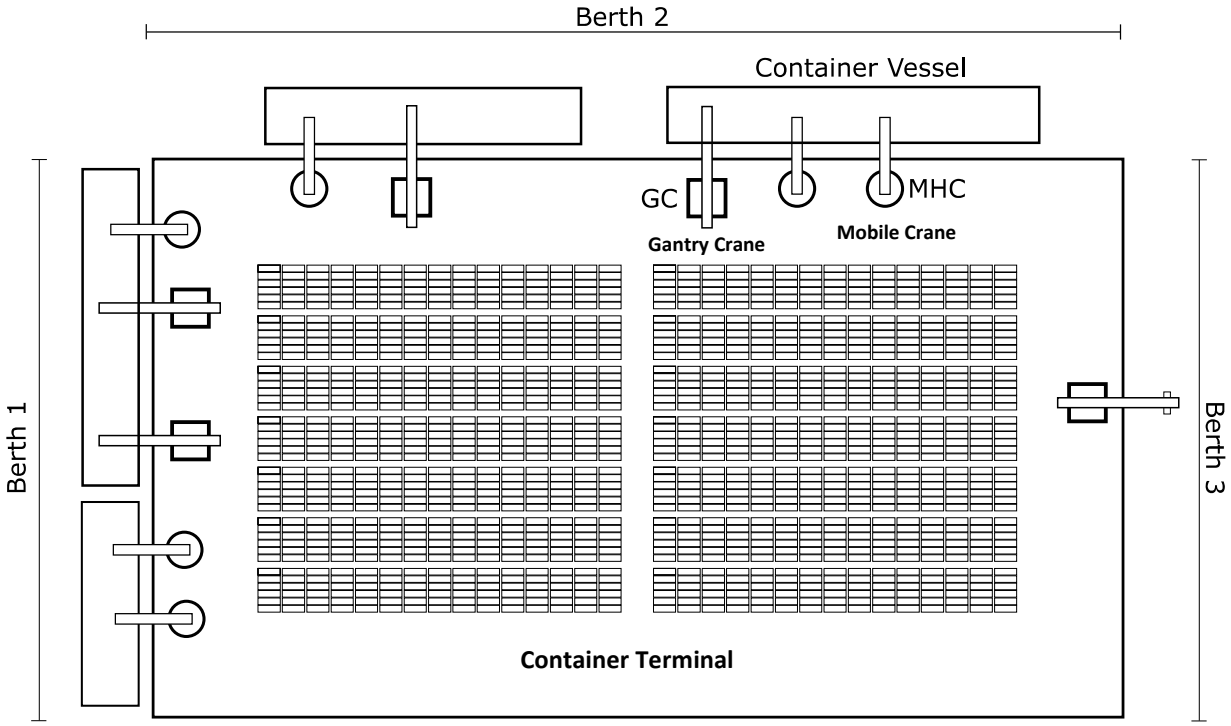

Figure 3. Schematic view of the examined seaport (an example seaport) layout and berths.

In the model, the crane allocation rule is simplified with considering the number of assigned cranes for each of the berths. The developed model assumes mobile harbor cranes which are

mobile and easily deployed using between successive berths. Apart from the mobile cranes, the berths also host ship-to-shore gantry type harbor cranes which are statically assigned for each berth and only can be mobilized on the mounted rails. In the study, the crane assignment was only evaluated for each berth and not for the vessels alone. With this simplified strategy, a total handling rate is determined using the number of the mobile and ship-to-shore cranes and the total handling rate was divided for each vessel using the berth proportion to the vessel length. This concept develops a suitable and meaningful model decomposition as cranes requires a specific berth length to operate and larger vessels allows wider space for multiple crane operation. With this concept, the hourly handling rate of each vessel is calculated with Eq.1.

$$R_i = \frac{L_i}{L} \cdot (N_m \cdot R_m + N_s \cdot R_s) \quad (1)$$

where;

R_i : Hourly handling rate for the vessel (containers/hour),

L_i : Vessel length (meter),

L : Total berth length (meter),

N_m : Total numbers of the mobile cranes,

N_s : Total numbers of the ship-to-shore type cranes,

R_m : Handling rate of the mobile cranes (Hourly),

R_s : Handling rate of the ship-to-shore type cranes (Hourly),

For the modeling concept of the study, several crane allocation policies were designed and numbered as given in $\vec{V}$: Policy control parameter vector.

P_i : The number stamp of the selected policy for i. time interval through the model execution clock.

Table 1 for container management. According to Table 1 for example, the model policy includes 2 mobile harbor cranes for the Berth 1-2 and a single mobile harbor crane for Berth 3. In the simulation process, model replication length was assigned as 360 days (a year). For observing identical model replications, singular model replication was also selected during the optimization process. The policy control parameter vector ($\vec{V}$) was then constructed using a single column vector format as shown in Eq. 2.

$$\vec{V} = \{P_1, P_2, \dots, P_N\} \quad (2)$$

where;

$\vec{V}$: Policy control parameter vector.

P_i : The number stamp of the selected policy for i. time interval through the model execution clock.

Table 1. The policy set matrix for mobile crane allocation for each berth.

Policy No	Crane Number in Berth 1	Crane Number in Berth 2	Crane Number in Berth 3
Policy 1	3	1	1
Policy 2	1	3	3
Policy 3	1	1	3
Policy 4	2	2	1
Policy 5	1	2	2
Policy 6	2	1	2

In the simulation process, the length of the each time interval was selected as a week hence a total of 52 parameters (52 weeks) were used for constructing the policy control vector. The developed simulation model was integrated with the OptQuest module of the Arena software. OptQuest is a generic optimizer module using a black-box design paradigm. With the proposed design, the problem is defined outside the simulation model. This technique resulted a complete separation between the simulation model and the optimization module. While the simulation model evolve through different states, the optimization cycle remains as unaltered. OptQuest utilizes the Information-driven Scatter Search (IdSS) algorithm exploiting the knowledge derived from the search space, and trajectories through the space over time. Scatter search algorithm (SSA) focuses on generating pertinent results while generating different solutions, owing to the generation procedure (rounded linear combinations). For each of the policy control parameter of P_i, the integer type was selected within the OptQuest with maximum and minimum values of 6 and 1 and the suggest value as selected as 4 with a step size of 1. For performing the simulation model and optimization, a hypothetical seaport and vessel data were generated. The lengths of the berths for the peninsula type seaport was selected as 350 meters, 450 meters and 600 meters (assumption). The used hypothetical vessel data is shown in Table 2.

Table 2. Container vessel classes.

Vessel Class	VID (hours)	Vessel Length (m)	Container Load
Class 1	EXPO(10)	NORM(80,10)	NORM(150,20)
Class 2	EXPO(15)	NORM(100,10)	NORM(180,20)
Class 3	EXPO(20)	NORM(150,10)	NORM(210,20)
Class 4	EXPO(25)	NORM(180,10)	NORM(240,20)

VID: Vessel Interarrival Distribution

3. Findings and Discussion

For the model performance assessment and decision making, the total handled containers value (N) was used. Without the stochastic system behavior and identical vessel generation pattern, for a specific time period, the number of the total handled containers strongly emphasize both the quality of the berth productivity and crane utilization. The OptQuest implemented the maximization study for a maximum of 2000 optimization cycles (iteration cycle) and approached to 673.980 containers as given in Figure 4.

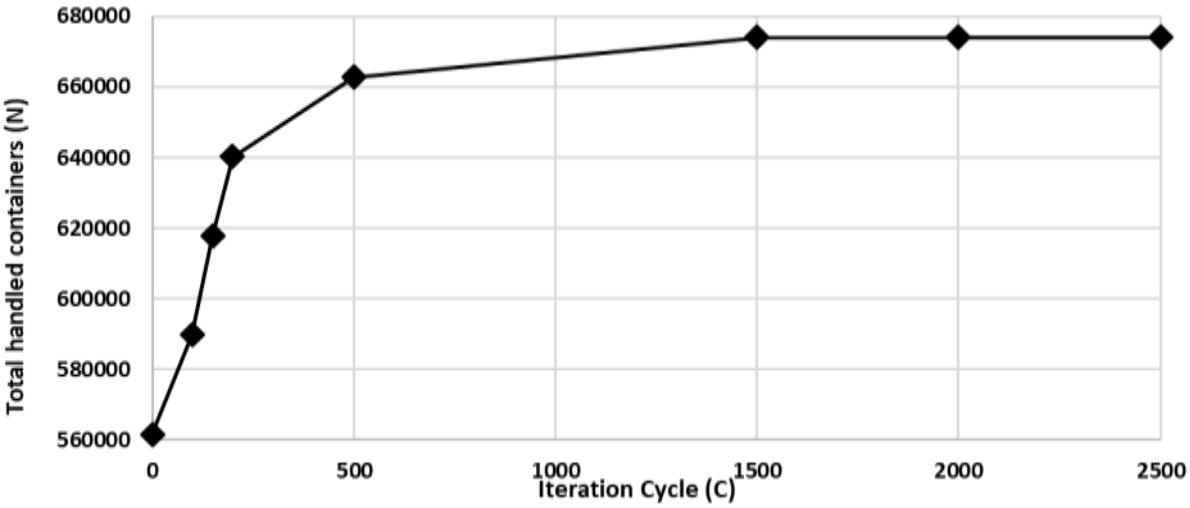

Figure 4. The change of the total handled containers with the iteration cycle (c).

The optimization study was terminated after reaching the maximum cycle limit of the algorithm (Approx. 2000 iteration). Using the optimized policy control vector ($\vec{V}$), the number of mobile cranes assigned for each berth for each week is given in Figure 5, Figure 6 and Figure 7 for Berth 1, Berth 2 and Berth 3 (respectively) during the model replication length of 360 days (a year period).

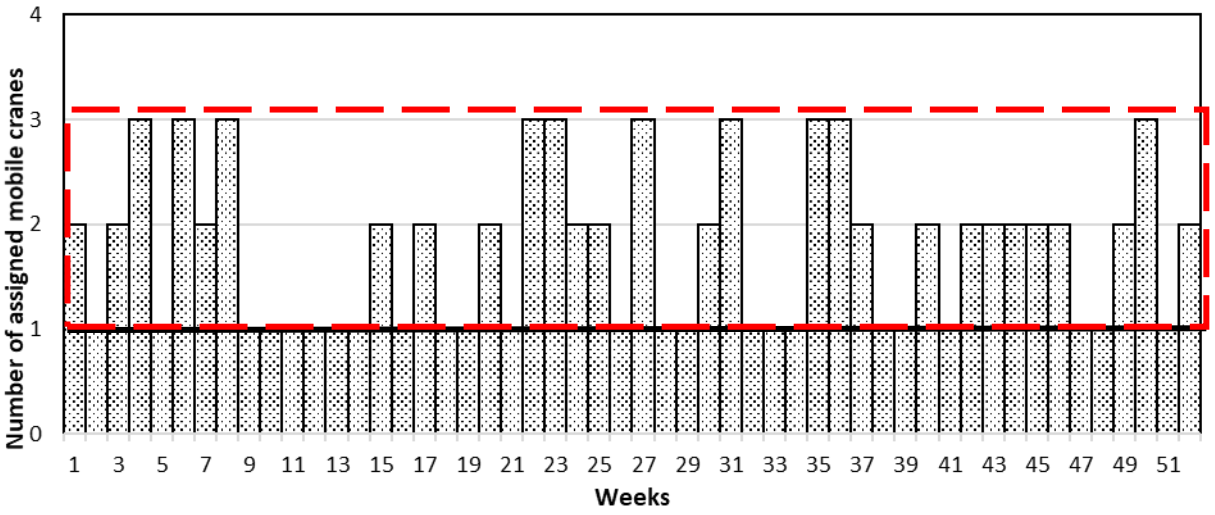

Figure 5. Optimized crane allocation policy for Berth 1.

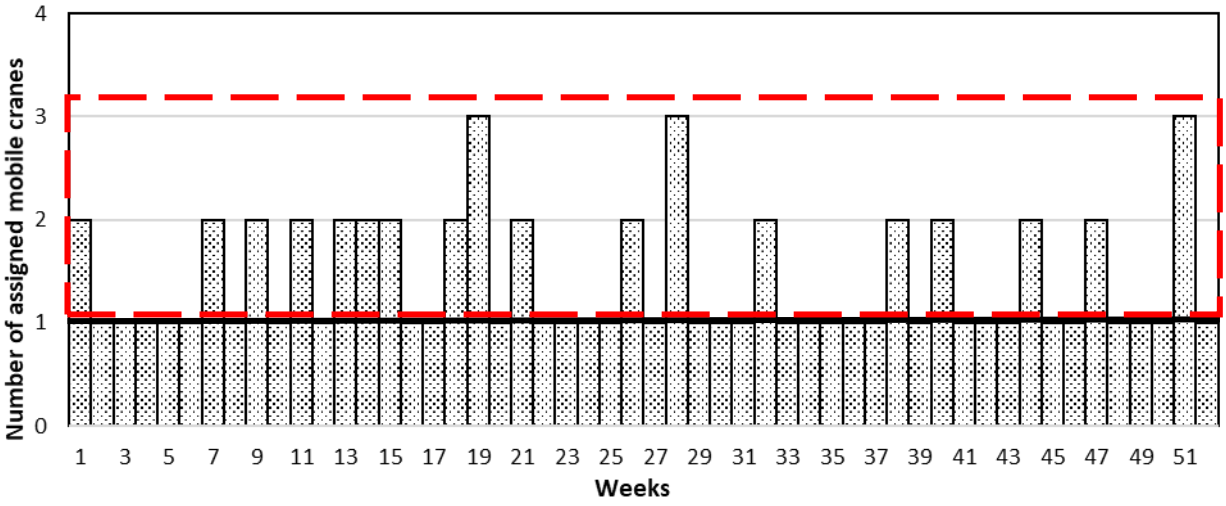

Figure 6. Optimized crane allocation policy for Berth 2.

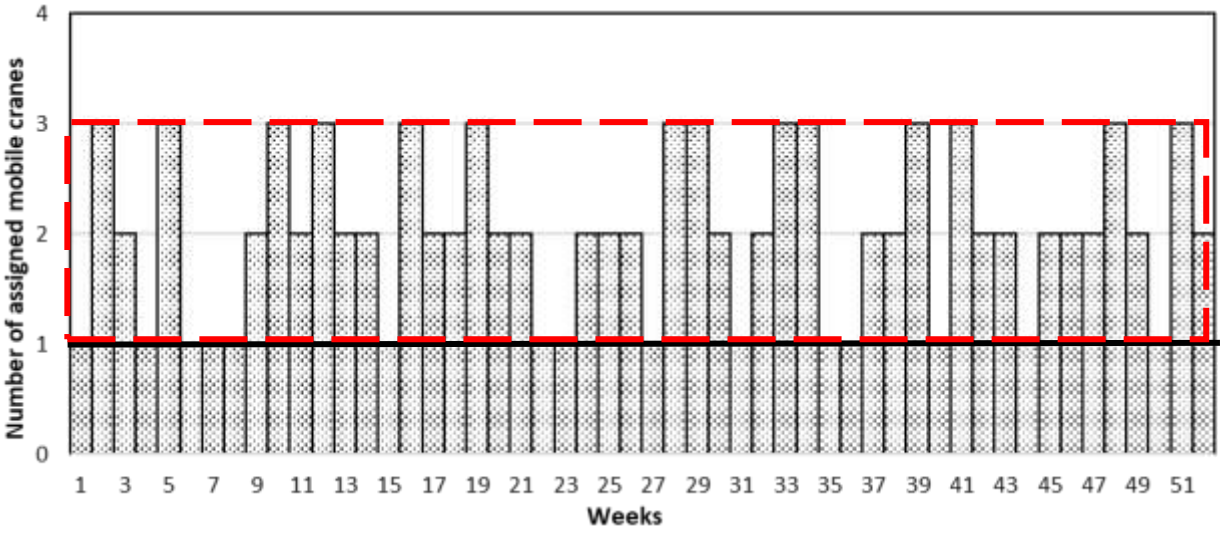

Figure 7. Optimized crane allocation policy for Berth 3.

It was seen from the Figure 5, Figure 6 and Figure 7, number of mobile cranes assigned for each berth for each week shows differences. As can also be seen from the figure comparisons that Berth 3 has the maximum assigned mobile cranes than other two (Berth 1 and Berth 2) berths. In summary, Berth 3 has the maximum and Berth 2 has minimum mobile cranes for flexible container terminal operations for a year (52 weeks) period. By optimizing the assigned mobile cranes (as shown in Figure 5-7), the total numbers of the handled containers were maximized for a seaport.

Conclusion

The crane allocation problem is one of the major issue influencing the performance of the seaports' handling rate and competitiveness. For this reason, to solve the crane allocation problems have a great importance for the seaport planners, decision makers and operators. The simultaneous utilization of the mobile and ship-to-shore type cranes provides a flexible operation scenario for the decision makers or operators for increasing the seaport cargo throughput. For this aim in the study, the allocation scenario of the mobile harbour cranes for different 3 berths was touched to speed up the specific container cargo operations and to increase the total numbers of the handled containers for a seaport (an example seaport). In the scope of the study, an Event-driven Micro-Simulation model (Ed-MSIM) was developed for simulation of the berthing and vessel operations with discrete phases of different crane assignment policies. The model was developed by using the Discrete Event Based (DEB) Arena® simulation software. In the study, developed model also simulated the vessel berthing with FCFS (First come, First serve) allocation rule and a single vessel berthing queue. In the simulation process, the length of the each time interval was selected as 1 week hence a total of 52 parameters (52 weeks) were used for constructing the policy control vector. A hypothetical seaport berth layout and vessel data were used for demonstrating the proposed optimization study. With the utilization of the optimized policy vector ($\vec{V}$), total numbers of the annual handled containers were increased from 561.650 to 673.980 (total 112.330 handled containers

increased). Obtained result show that optimization of crane allocation policies for a case container terminal have a great effect (≈20% capacity increase). In summary, it can be concluded from the analysis results that the implementation of a dynamic crane allocation policies for berths can increase the handled containers at seaports.

Acknowledgments

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TRANSFER HATTI TAŞIYICI KONSTRÜKSİYONUN MODAL VE YAPISAL ANALİZ ÇALIŞMALARI

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ÖZET

Bu çalışmada, bir otomobil fabrikasında kullanılacak olan parça transfer hattının tasarım aşamalarına yardımcı olmak amacıyla gerçekleştirilen analiz çalışmaları ve bu analiz çalışmalarından elde edilen tecrübeler üzerinde durulmuştur. Bu tecrübeler hat tasarımında benzer ürün geliştirmelerde oldukça önemlidir. İmalat öncesinde gerçekleştirilen tasarım ve analiz çalışmaları imalatın sorunsuz bir şekilde yapılabilmesini garanti ederler. Bu nedenle tasarım aşamalarına süreç içinde özel önem verilmeli ve tasarım her yönü ile elden geçirilerek alternatif çözümler oluşturulmalıdır. Bu çözümler içerisinden en iyi tasarımın seçilmesi için de analiz çalışmaları yapılmalıdır. Günümüzün özel analiz yazılımlarının kullandığı yaklaşım olan sonlu elemanlar yaklaşımı bu çalışmada tercih edilmiştir. Sınır şartları belirlenen model üzerinde birçok analiz gerçekleştirilmiş ve tasarımın gerçek hayattaki davranışı öngörülmeye çalışılmıştır. Analiz çalışmalarında dinamik davranışın anlaşılması için modal analizler ve yapısal yer değiştirmelerin sınırlar dahilinde kalacağının ve gerilmelerin belirli sınırları aşmayacağının anlaşılması için de yapısal analizler gerçekleştirilmiştir. Analiz çalışmalarında bir sonlu elemanlar temelli çalışan bir simülasyon yazılımı kullanılmıştır. Burada geçmiş deneyimlere dayanan tasarım tecrübelerinin önemi tasarımın eniyileme çalışmalarında ortaya çıkmıştır.
Bildiri içerisinde de sunulacak olan tasarım adımları ve tasarım üzerinden elde edilen analiz sonuçları prototip imalat aşamasında da çok faydalı olmuş ve transfer hattı emniyetli bir şekilde ortaya konmuştur. Denemeler sonucunda transfer hattı müşteriye teslim edilmiş olup halen güvenle görevini yerine getirmektedir.

Anahtar Kelimeler: Otomotiv, Transfer Hattı, Tasarım, Prototip İmalat

MODAL AND STRUCTURAL ANALYSIS STUDIES OF THE TRANSFER LINE CARRIER CONSTRUCTION

ABSTRACT

In this study, the analysis studies carried out to assist the design stages of the part transfer line to be used in an automobile factory and the experiences gained from these analysis studies are emphasized. These experiences are very important in similar product developments in industrial design. Design and analysis studies carried out prior to manufacturing ensure that production can be carried out without any problems. For this reason, special importance should be given to the design stages in the process and alternative solutions should be created by revising the design in every aspect. Analysis studies should be carried out to select the best design among these solutions. The finite element approach, which is the approach used by today's special analysis software, was preferred in this study. Many analyses were carried out on the model whose boundary conditions were determined and the real-life behaviour of the design was foreseen. In the analysis studies, modal analyses and structural displacements were carried out in order to understand the dynamic behaviours and the stresses will not exceed certain limits. A finite element based simulation software was used in the analysis studies. Here, the importance of design experiences based on past experiences has emerged in the optimization of the design.
The design steps to be presented in the paper and the analysis results obtained through the design were also very useful in the prototype manufacturing phase and the transfer line was safely demonstrated. As a result of the trials, the transfer line was delivered to the customer and still fulfils its duty safely.

Keywords: Automotive, Carrier Lines, Design, Prototype

VOLLASTONİT VE MANYETİT KATKILARININ RİJİT POLİÜRETAN KÖPÜKLERİN ÖZELLİKLERİNE OLAN ETKİLERİNİN İNCELENMESİ

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ÖZET

Poliüretan (PU) köpükler işleme kolaylığı sebebiyle yalıtım, otomobil veya yapıştırıcılar gibi çeşitli uygulamalarda kullanılan polimer malzemeler olmakla birlikte bu malzemeler sert ve esnek köpükler olarak kullanılabilirler. Poliüretan köpükler düşük mekanik mukavemetleri ve düşük termal kararlılıkları olmasına rağmen yaygın kullanılan yalıtım malzemelerine kıyasla daha iyi termal ve ses bariyeri özelliklerine sahiptirler. Bu malzemelerin nihai özelliklerini hücre boyutu, hücre boyutu dağılımı ve hücre yoğunluğu gibi mikroyapısal özellikler belirlemektedir. Bu çalışmada, vollastonit ($CaSiO_3$) ve manyetit (Fe_3O_4) takviyeli sert poliüretan köpüklerin mikroyapı, termal ve elektriksel iletkenlik özelliklerinin incelenmesi amaçlanmıştır. Özellikle katkı miktarının PU/$CaSiO_3$ ve PU/Fe_3O_4 kompozitlerin ve PU/$CaSiO_3$/Fe_3O_4 hibrit sistemlerin nihai özellikleri üzerindeki etkisi araştırılmıştır. Bu çalışmalar sonucunda poliüretan köpüğe katkı maddelerinin eklenmesinin hücre boyutunda bir azalmaya neden olduğu ve homojen bir hücre boyutu dağılımının elde edildiği belirlenmiştir. Ayrıca sonuçlara göre hibrit sistemler söz konusu olduğunda, PU/$CaSiO_3$/Fe_3O_4 hibrit kompozitler için dolgu oranının 1:1 olduğu durumlarda, PU/$CaSiO_3$ ve PU/Fe_3O_4 kompozitlerle kıyasla optimum termal ve elektriksel iletkenlik özellikleri sergiledikleri gözlemlenmiştir.

Anahtar kelimeler: Rijit Poliüretan Köpük, Vollastonit, Manyetit, Isıl İletkenlik, Elektriksel İletkenlik, Mikroyapı

INVESTIGATION OF THE EFFECTS OF MAGNETITE AND WOLLASTONITE ON THE PROPERTIES OF RİGİD POLYURETHANE FOAMS

ABSTRACT

Polyurethane (PU) is a polymer material which is used for various applications such as insulation, automobile or adhesives due to its ease of processing and these materials can be used as rigid and flexible solid foams. Instead of their low mechanical strength and low thermal stability, polyurethane foams have better thermal and sound barrier properties compared to common insulation materials. The final properties of these materials are mainly controlled by their microstructural characteristics such as cell size, cell size distribution or cell

density. In this work, it is aimed to study the thermal and electrical conductive and microstructure properties of wollastonite ($CaSiO_3$) and magnetite (Fe_3O_4) reinforced rigid polyurethane foams. In particular, the effect of the filler content on the final properties of PU/$CaSiO_3$ and PU/Fe_3O_4 composites and PU/$CaSiO_3$/Fe_3O_4 hybrid systems were investigated. As a result of these studies, it has been determined that the addition of fillers to the polyurethane foam induced a decrease of the cell size and a homogeneous cell size distribution is obtained. Furthermore, the results showed that in the case of hybrid systems, a filler ratio of 1:1 for PU/$CaSiO_3$/Fe_3O_4 hybrid composites exhibited optimum thermal and electrical conductive properties compared to PU/$CaSiO_3$ and PU/Fe_3O_4 composites.

Keywords: Rigid Polyurethane Foam, Wollastonite, Magnetite, Thermal Conductivity, Electrical Conductivity, Microstructure

SİLİSYUM KARBÜR VE MANYETİT KATKILI HİBRİT POLİMER KOMPOZİTLERİN ÖZELLİKLERİNİN ARAŞTIRILMASI

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ÖZET

Polipropilen (PP) ve poliamid 6 (PA6) gibi yaygın olarak kullanılan polimerler, düşük ısıl iletkenliğine sahip elektrik yalıtkanlardır. Isı alıcıları gibi, radyo frekansı girişimi korumasında veya elektronik ambalajda yeni uygulamalar daha yüksek ısı ve elektrik iletkenliğine sahip yeni kompozitler gerektirmektedir. Ayrıca, eşzamanlı olarak polimerin manyetik özellikleri, uygun bir dolgu maddesi kullanılarak özelleştirilebilir. Tipik manyetik ve elektriksel özellikleri nedeniyle, manyetit (Fe_3O_4), örneğin polimerler ile karışım halinde tercih edilen ve en iyi karakterize edilmiş dolgu malzemelerinden biridir. Ek olarak, manyetit, inşaat endüstrisindeki manyetik ürünler için sert ve X-radyasyonun emilmesi ya da askeri veya sivil ürünlerde mikrodalga emiciler (elektromanyetik koruma) olarak kullanılmaktadır. Bu çalışmada silisyum karbür (SiC) ve Fe_3O_4 katkılı polipropilen ve poliamid 6 polimer kompozitler farklı katkı miktarlarında, ekstrüzyon yöntemi ve sıkıştırmalı kalıplama ile hazırlanmıştır ve elde edilen kompozitlerin elektriksel iletkenlik, mikroyapı ve mekanik özelliklerine etkileri incelenmiştir. Bu çalışmalar sonucunda, katkıların polimer içerisinde iyi bir dağılım sağladığı gözlemlenmiştir. Ayrıca, sonuçlara göre, 1:1 katkı oranlarında hazırlanmış olan PA6/ SiC /Fe_3O_4 ve PP/ SiC /Fe_3O_4 hibrit sistemlerde katkı oranı arttıkça elektriksel iletkenlik değerinin azaldığı ve kompozitlerin elastik modül değerlerinde artış gözlemlenmiştir.

Anahtar Kelimeler: Poliamid 6, Polipropilen, Silisyum Karbür, Manyetit, Elektriksel İletkenlik, Mikroyapı

STUDY OF THE PROPERTIES OF SILICON CARBIDE AND MAGNETITE FILLED HYBRID POLYMER COMPOSITES

ABSTRACT

Commonly used polymers such as polypropylene (PP) and polyamide 6 (PA6) are electrical insulators with low thermal conductivity. New applications in radio frequency interference protection or electronic packaging, like heat sinks, require new composites with higher heat and electrical conductivity. Also, the magnetic properties of the polymer can be customized simultaneously using a suitable filler. Due to its typical magnetic and electrical properties, magnetite (Fe_3O_4) is one of the preferred and best characterized filling materials, in the case of polymers/magnetite mixtures. In addition, magnetite is used as hard and X-radiation absorption for magnetic products in the construction industry or as microwave absorbers (electromagnetic shielding) in military or civilian products. In this study, silicon carbide (SiC) and Fe_3O_4 reinforced polypropylene and polyamide 6 polymer composites were prepared at different filler content by extrusion method and compression molding and the effects of the composites obtained on electrical conductivity, microstructure and mechanical properties were investigated. As a result of these studies, it has been observed that the fillers provide a good dispersion in the polymer. Furthermore, according to the results, in PA6/ SiC /Fe_3O_4 and PP/ SiC /Fe_3O_4 hybrid systems prepared at 1:1 filler ratios, the electrical conductivity value decreased and the elastic modulus values of composites increased.

Keywords: Polyamide 6, Polypropylene, Silicon Carbide, Magnetite, Electrical Conductivity, Microstructure

SAC ŞEKİLLENDİRME İŞLETMESİNDE SMED ÇALIŞMASINA BİR ÖRNEK

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ÖZET

SMED, Single Minute Exchange of Dies (Tekli Dakikalarda Kalıp Değişimi), üretim süreci boyunca oluşan kalıp değişiminden kaynaklanan kayıpları minimize etmek için kullanılan önemli bir yöntemdir. Özellikle otomotiv sektöründe saniyeler bile önemli iken dikkatsiz tasarlanan kalıplar ve bu yanlış tasarımın bir sonucu olarak uzun süren kalıp değişim süreleri üretimi ciddi anlamda olumsuz etkilemektedir ve verimliliği düşürmektedir. Mümkün olan en kısa sürede, en kaliteli ürünü üretmek günümüzün önemli gereksinimlerindendir. Bu kapsamda SMED yöntemi bu çalışmanın temel kaynağı olarak kullanılmıştır.

Bu çalışmada, işletmede kullanılan manuel pres hattında üretilen 6 farklı ürün için kullanılan kalıplar referans alınmıştır. Bu 6 ürün manuel üretimin %85'ini oluşturan ürünlerdir. Ürünler maksimum 5 farklı manuel pres kullanılarak üretilmektedir. Bu preslerde ürünlerin kalıp değişim süreleri 3,5 aylık bir gözlem sonucu belirlenmiştir. Bu süreler detaylı bir şekilde incelenerek, kalıp tasarımından veya kullanılan bağlama ekipmanlarından kaynaklı olduğu tespit edilmiştir. Kalıplar üzerinde yapılabilecek iyileştirmeler ve kullanılan ekipmanlarda yapılacak yenilikler veya iyileştirmeler belirlenmiştir. Gerekli iyileştirmeler yapıldığı zaman oluşacak kazanç hesaplanarak SMED yaklaşımının sac imalat sektörüne etkisi hakkında kantitatif sonuçlar verilmiştir.

Anahtar Kelimeler: SMED, Kalıp Tasarımı, Kalıp Değişim Süresi, Kalıp Bağlama

AN EXAMPLE OF SMED STUDY IN SHEET SHAPING OPERATION

ABSTRACT

SMED, Single Minute Exchange of Dies is an important method used to minimize losses caused by die change during the production process. Especially in the automotive industry, even the seconds are important, carelessly designed dies and long-term die change durations seriously affect the production and reduces productivity. To produce the highest quality in a possible short time is one of the important requirements of today. In this context, the SMED method was used as the main source of this study.

In this study, the dies of 6 different products produced in the manual press line in the enterprise are taken as reference. These 6 products consist of 85% of manual production. The products are produced using a maximum of 5 different manual presses. In these pressing process, the die change duration of the products were determined after 3.5 months of observation. These durations were examined in detail and it was determined that the durations stem from die design or clamping equipment used. The improvements that can be made on the dies and the innovations or improvements to be made on the equipment used were determined. Quantitative results were given about the effect of SMED approach on the sheet metal fabrication sector by calculating the earnings that will occur when necessary improvements are made.

Keywords: SMED, Die Design, Die Change Time, Die Binding

SAC ŞEKİLLENDİRME İŞLETMESİNDE FİRE YÖNETİMİ ÇALIŞMASINA BİR ÖRNEK

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ÖZET

Sac metal şekillendirme günümüzde özellikle otomotiv sektöründe önemli bir yere sahiptir. Sac metalin en verimli şekilde kullanılarak mümkün olduğunca az fire miktarı ile üretim yapmak için şekillendirmede kullanılacak olan kalıpların tasarımı ve ürün dizaynı önemli bir parametredir. Üretilecek ürüne yönelik fire miktarı öngörülmeden yapılan kalıp ve ürün tasarımının yüksek fire oranına sebep olacağı kaçınılmazdır. Gerek ürünün gerekse kalıbın tasarımında ürünün fonksiyonelliği yanında, yarı mamulün efektif kullanım miktarı, fire ve hurda miktarının da dikkate alınıp hesaplanması ve maliyetlendirilmesi gereklidir.

Bu çalışmada, 3,5 aylık süreçte işletmede üretilen yüksek kapasiteye sahip parçaların mevcut imalat durumundaki konumları ile hatve miktarları incelenmiştir. Bu incelemeler sonucu mevcut durumda sac metal kullanım verimlilikleri düşük olan parçalar ayırt edilmiştir. Ayırt edilen bu parçalar için, literatürde önerilen konum ve hatve önerileri ile ilgili araştırmalar yapılmıştır. Parça konum ve hatveleri bilgisayar ortamında fire miktarı azaltılarak verimlilik artacak şekilde yeniden modellenmiştir. Böylece yarı mamul sacın daha verimli kullanılmasına ilişkin örnekler oluşturulmuş ve elde edilen kazanç hesaplanmıştır.

Anahtar kelimeler: Sac Şekillendirme, Fire Oranı, Parça Yerleştirme Planı

AN EXAMPLE OF SCRAP MANAGEMENT IN SHEET METAL FORMING

ABSTRACT

Sheet metal forming has an important place in the automotive industry today. Design of the dies to be used in shaping and product design is very important parameter to produce with as little scrap as possible using the sheet metal in the most efficient way. It is inevitable that the die and product design, which is made without predicting the amount of scrap for the product to be produced, will cause high waste rate. In the design of both the product and the die, besides the functionality of the product, the effective use amount of the semifinished-product, the amount of waste and scrap should also be taken into account and costed. These approaches significantly reduce the amount of scrap and help to use sheet metal more efficiently and increase the gain.

In this study, the locations in the current manufacturing situation and pitch amounts of the high capacity parts produced in the enterprise in the 3.5-month period were examined. As a result of these examinations, the parts that have low sheet metal usage efficiencies are distinguished. For these parts, researches have been made on the position and pitch suggestions proposed in the literature. Part location and pitches have been re-modeled to increase efficiency by reducing the amount of scrap in the computer environment. Thus, examples of more efficient use of semi-finished sheet metal were created and the earnings were calculated.

Keywords: Sheet Metal Forming, Scrap Rate, Parts Placement Plan

ARTIFICIAL INTELLIGENCE APPLICATIONS FOR PREDICTING SEA SURFACE TEMPERATURE (SST)

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ABSTRACT

Sea surface temperature (SST) is one of the most important parameters in earth observation for monitoring of the global climate. SST has a significant role in the process of interactions between atmosphere and surface of the earth. It is a significant dynamic in the energy balance system, and is a critical parameter for understanding and forecasting of rainfalls and hurricanes.The forecast of SST is also a significant and major issue in numerous application fields such as estimating ocean/marine/lake climate, offshore accomplishments like fishing and mining, environmental protection, marine military affairs. It is important in science research and application to forecast precise spatial and temporal distribution of SST.

Artificial intelligence (AI) techniques are commonly applied approaches for SST predicting, environmental monitoring, assessment, and forecasting. Data-driven approaches have emerged as an attractive strategy to describe certain dynamic models with increased observation and simulation data. Accurate forecasting of SST is required due to significant impacts of several factors on the interactions between sea surface and atmosphere. Gene expression programming (GEP), adaptive neuro fuzzy inference system (ANFIS), and artificial neural networks (ANNs) can have conclusive role in predicting SST. Although fuzzy logic and genetic algorithms are also beneficial artificial intelligence approaches, commonly used artificial intelligence approach for predicting SST is artificial neural network. Neural networks are presently the state-of-the-art approaches for an extensive variety of machine learning concerns. Neural networks are efficient and remarkable data-driven approaches for estimating and reconstruction of sea surface dynamics. Neural networks technique is talented in SST forecasting, on the other hand, it prerequisites various applications and more investigation to achieve its full potential. In further researches, performance of different artificial approaches should be compared and the most accurate artificial intelligence approaches for predicting SST should be determined.

Keywords: Artificial Intelligence, Forecast, Neural Networks, Sea Surface Temperature, SST

HETEROJEN YEŞİL ARAÇ ROTALAMA OPTİMİZASYONUNUN GIDA SEKTÖRÜNDE UYGULANMASI

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ÖZET

Günümüzde en büyük problemlerden biri olan iklim krizi, temel olarak insan faaliyetleri nedeniyle ekolojik dengenin bozulması ve aşırı fosil yakıt tüketimiyle oluşan karbon emisyonunun tüm canlılara, çevreye ve ekonomiye tehdit yaratması ile ortaya çıkmıştır. İklim krizi tehditlerinin yüksek oranda artması, şirketlerin kurumsal sorumluluk bilinciyle davranarak çevresel tedbirler almasını zorunlu hale getirmiştir. Bu kapsamda alınan tedbirlerden birisi de çevreci stratejiler ile taşımacılık faaliyetlerinin optimize edilmesidir ve böylelikle yeşil lojistik stratejisi karşımıza çıkmaktadır. Bu çalışmada, taşımacılık faaliyetlerinden araç rotalama, yeşil lojistik bakış açısıyla ele alınarak yeşil araç rotalama problemi araştırılmıştır. Yeşil araç rotalama probleminin çözümü yapılırken asıl amaç, araçların gideceği toplam yolu minimize etmek değil; harcanan enerjiyi ve yakıt tüketimini minimize ederek karbon emisyonu salınımını azaltmak olmuştur. Çalışmada kapsamında optimal çözümü elde edebilmek için optimizasyon tekniklerinden biri olan analitik yöntem tercih edilmiştir ve ilk olarak yeşil araç rotalama problemi için önerilen karma tamsayılı matematiksel model kurulmuştur. Model kurulurken; yolun eğimi, araç ağırlığı, hacmi, boyutları, araç üzerinde taşınan anlık yük miktarı, taşınan yükün hacim ve ağırlığı, araç aerodinamik yapısı, yuvarlanma direnci, hız, seyahat mesafesi gibi birçok kısıt dikkate alınmıştır. Genellikle çalışmalarda homojen kabul edilen araç filosu heterojen filo; tek tip kabul edilen ürün çeşidi ise heterojen ürün çeşitli olarak kabul edilip model oluşturulmuştur. Önerilen model için gıda sektöründe faaliyet gösteren bir işletmeden veriler alınıp probleme uyarlanarak IBM Ilog Cplex programıyla optimal sonuca ulaşılmıştır. Sonuç olarak işletmeden verisi alınan 3 farklı aracın her biri için, karbon emisyonunu minimize edecek şekilde Ege bölgesindeki 9 müşteriye hangi aracın hangi rotalardan gideceği sonucu optimal bir şekilde elde edilmiştir. Çalışma, optimal sonuç için önerilen matematiksel modeli ve gıda sektöründeki uygulaması ile özgündür. Ayrıca çalışma; sağlık, gıda, tekstil, otomotiv, eğitim, tarım, ormancılık gibi sektörlerde lojistik faaliyetler içeren birçok işletme için çevreci hizmetler üretmek adına konu ile ilgili literatüre katkıda bulunmaktadır.

Anahtar Kelimeler: Araç Rotalama Problemi, Optimizasyon, Yeşil Araç Rotalama, Yeşil Lojistik.

IMPLEMANTATION OF HETEROGENEOUS GREEN VEHICLE ROUTING OPTIMIZATION IN FOOD INDUSTRY

ABSTRACT

The climate crisis, which is one of the biggest problems today, has emerged mainly due to the deterioration of ecological balance due to human activities and the carbon emission caused by excessive fossil fuel consumption threatening all living things, the environment and the economy. The high increase in the threats of the climate crisis has made it compulsory for companies to take environmental measures by acting with corporate responsibility awareness. One of the measures taken in this context is to optimize transportation activities in company with environmentalist strategies, and thus green logistics strategy becomes important. In this study, vehicle routing from transportation activities is handled with a green logistics perspective and green vehicle routing problem is investigated. While solving the green vehicle routing problem, the main purpose is not to minimize the total road that the vehicles will go; It has been to reduce the emission of carbon emissions by minimizing the energy used and fuel consumption In the study, one of the optimization techniques, an analytical method, was preferred in order to obtain the optimal solution, and firstly the mixed integer mathematical model proposed for the green vehicle routing problem was established. While building the model; many constraints such as slope of the road, vehicle weight, vehicle volume, vehicle dimensions, amount of instant load carried on the vehicle, volume and weight of the carried load, vehicle aerodynamic structure, rolling resistance, speed, travel distance are taken into account. The vehicle fleet, which is generally considered homogeneous in the studies, has been accepted as the heterogeneous fleet; the product type, which is generally accepted as a uniform type, is considered as a heterogeneous product variety and the model is formed. For the proposed model, the data from a business in the food sector were obtained and adapted to the problem, and then the optimal result was achieved with the IBM Ilog Cplex program As a result, for each of the 3 different vehicles whose data is taken from the business, the result of which vehicle will go on which routes to 9 customers in the Aegean region by minimizing carbon emission, has been obtained optimally. The study is specific with its mathematical model proposed for optimal results and its application in the food industry. Also study; It contributes to the relevant literature to produce environmentally friendly services for many businesses involving logistics activities in sectors such as health, food, textile, automotive, education, agriculture, forestry.

Keywords: Vehicle Routing Problem, Optimization, Green Vehicle Routing, Green Logistics.

METİL PROKSİTOL (PM) KULLANIMI İLE BİYODİZEL YAKITININ SOĞUK AKIŞ ÖZELLİKLERİNİN İYİLEŞTİRİLMESİ

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ÖZET

Biyodizelin soğuk akış özellikleri dizel yakıtına oranla daha kötüdür ve soğuk havalarda ilk çalıştırma esnasında sorunlara neden olabilir. Biyodizelin yağ asidi kompozisyonuna ve alkil gruplarına göre soğukta akış özellikleri iklim koşullarına göre değişkenlik gösterir. Yüksek miktarda doymuş yağ asidi içeren biyodizellerin akma noktası, bulutlanma noktası ve soğuk filtre tıkanma noktası değerleri yüksektir. Dolayısıyla kış aylarında soğuk akış özelliği iyi olmayan yakıt kullanımı motorun yakıt besleme elemanlarına hasar verir ve motorda ilk hareket problemlerine neden olur. Düşük sıcaklıklarda yakıtın özelliklerini koruma yeteneği soğukta akış performansı olarak adlandırılır. Dizel yakıtın en fazla % 20si göreceli olarak ağır moleküllerden (parafin) oluşabilir. Düşük sıcaklıklarda bu ağır parafin molekülleri ayrışarak parafin mumu oluşturur ve çökelirler dolayısıyla yakıt hat ve filtrelerinin tıkanmasına neden olurlar. Bu durum motorun güç kaybetmesine ve/veya stop etmesine neden olur. Yakıt sistemine, yakıt filtresinden hemen sonra veya filtre ile akuple edilmiş bir ısıtıcı ilavesi biyodizelin soğuk havalarda kullanımı sırasında oluşan viskozite problemine çözüm sağlamaktadır. Biyodizel ve biyodizel-dizel karışımları, dizelden daha yüksek akma ve bulutlanma noktasına sahip olduklarından yakıtların soğukta efektif bir şekilde kullanılmaları için uygun katkı maddelerinin (metil proksitol, etil proksitol, anti-jel maddeleri) kullanılması öngörülmektedir. Bu çalışmada biyodizel yakıtına %2, %5 ve %7 oranlarında metil proksitol katkı maddesi katılarak elde edilen yakıt karışımlarının başta yoğunluk (880,882,883kg / m^3) ve viskozite (4.04, 3.69 and 3.48 mm^2/s) değerleri akabinde de akma noktası ((-51, -53 and -57^oC), bulutlanma noktası (-57.4, 60.2 and 63.6^oC), soğuk filtre tıkanma noktası ((-54, -56 and -59^oC) değerleri ölçülmüştür.

Anahtar Kelimeler: Biyodizel, Soğuk akış özellikleri, Akma noktası, Bulutlanma noktası, CFPP

ABSTRACT

Cold flow properties of biodiesel are worse compared to diesel fuel; and this may cause problems during first start in cold weather. Cold properties of biodiesel exhibit variations according to oil acid composition and alkali groups in cold climates. Biodiesel containing high amount of saturated fatty acids has high pour point, cloud point and cold filter plugging point values. Therefore, the use of fuel, with no good cold flow properties, damages the fuel supply elements of the engine and causes first movement problems. The ability to maintain the properties of fuel at low temperatures is called cold flow performance. Up to 20% of diesel fuel may consist of relatively heavy molecules (paraffin). At low temperatures, these heavy paraffin molecules decompose to form paraffin wax and precipitate, causing clogging of fuel lines and filters. This causes the engine to lose power and/or stop. Adding a heater to the fuel system immediately after the fuel filter or with a filter coupled provides a solution to the viscosity problem that occurs during the use of biodiesel in cold weather. Since biodiesel and biodiesel-diesel blends have higher pour and cloud point values than that of diesel, it is envisaged to use suitable additives (methyl proxytol, ethyl proxytol, anti-gel substances) for effective use of fuels in the cold. In this study, biodiesel fuels, 2%, 5% and 7% in the fuel mixture density (880,882,883kg / m^3) and viscosity (4.04, 3.69 and 3.48 mm^2/s) values are then obtained by joining the additive methyl proksitol pour point (-51, -53 and -57^oC), cloud point (-57.4, 60.2 and 63.6^oC), cold filter plugging point (-54, -56 and -59^oC) values were measured.

Keywords: Biodiesel, Cold flow properties, Pour point, Cloud point, CFPP, Methyl Proxytol

IMPROVEMENT OF COLD FLOW PROPERTIES OF BIODIESEL BY USING METHYL PROXYTOL (PM)

1. INTRODUCTION

Increasing population and living standards in the world have increased energy consumption in large scales. Merely since 1950, the world population has more than doubled; and it is expected that it will increase 40% more until 2050 [1, 2]. These data make it unavoidable to find a solution to energy problem. On the one hand scientists search for how to meet the increasing energy needs; on the other hand, they try to do this by employing economically, environmentally and socially sensitive methods as well as including combating greenhouse gas emissions. People should use the energy sources in the world more carefully; hence, they should emphasis on R&D and innovation studies. In order to realize all these, the transition processes to renewable energy sources should be accelerated [3]. Renewable energy sources have gained importance because they will never run out, and there is no harm to the environment, and their cost is much less than fossil fuels. As the fact that this great energy hunger in the world cannot be met with non-renewable energy sources, namely fossil fuels

(coal, oil, and natural gas), the need and interest in renewable energy sources have increased. The energy obtained from fossil fuels has started to damage our planet day by day [4]. Sustainable energy means using as much energy as needed without risking it [5]. The importance of renewable energy sources for the future of the world and Turkey is great in this respect. The importance of renewable energy sources for the future of Turkey is increasing every day. Investments in renewable energy should be increased, especially these days when we are increasingly feeling the effects of climate change. When using renewable energy sources in Turkey it can be obtained the following results.

i. Dependence on imported fuels will decrease.
ii. Priority will be given to domestic resources.
iii. Employment will increase as a result of domestic production.
iv. It will enable sustainable economic growth and development.
v. Energy supply security will increase.
vi. With the security provided to meet the energy demand, the sectors that use energy will be positively affected and this will encourage them to invest.
vii. Stability will increase with the trust in environment provided in production and consumption.
viii. Welfare and stability will increase in social and economic life.

Biomass energy is one of the primary sources to be used to provide sustainably energy without causing environmental pollution [6]. Since biomass energy is an inexhaustible source and it can be obtained everywhere, it is seen as an appropriate and important energy source, especially because it helps socio-economic developments of rural areas [7]. For biomass, specially grown plants such as corn, wheat, herbs, algae, algae at sea, animal droppings, fertilizer and industrial wastes, and all organic wastes (fruit and vegetable) from houses are sources [8]. The use of biomass is becoming increasingly important to solve the energy problem because of the limited energy resources such as oil, coal and natural gas, as well as their environmental pollution [9].

Advantages of bio-mass energy [10-12]; It is known that energy production using fossil fuel sources damages the environment. Any energy source to be used is now being evaluated together with its environmental impact. Global environmental problems are directly dependent on the energy consumed, more precisely on the use of fossil fuels containing high levels of sulfur and other harmful substances. While the energy consumption in the world has increased 17 times in the last century, harmful gases such as CO_2, SO_2 and NOx originating from fossil fuels and discharged into the atmosphere have increased at the same rate. With the regional and modern operation of biomass, it is possible to create residential areas that are developing with self-sufficient energies, especially in remote areas. For the production of energy from biomass, as more agricultural work is required, the issue of bio-energy is an ideal option for creating business areas especially in rural areas. It is possible to prevent migration from rural areas to big cities, which is one of the biggest problems developing countries face. Biomass grows in very barren areas and is of great importance for the use of previously unavailable soils and the evaluation of rural areas in terms of cultivation.

Biodiesel, which is the sub-subject of biomass energy that is among the renewable energy sources, is an alternative fuel obtained from vegetable or animal origin oils [13]. Production of biodiesel fuel is easier than other alternative energy sources (such as wind energy and solar energy). Its production is becoming widespread day by day due to its low cost. Along with this, biodiesel, a sustainable type of energy, creates new jobs, especially in rural areas, by ensuring that industry, agriculture and environmental fields work together [14]. However, the cold flow properties of biodiesel are worse than diesel fuels and can cause problems during cold start-up [15-18]. However, while converting these oils into biodiesel, it is predicted that the cold flow properties of the fuel can be improved by using alcohols such as methanol, ethanol, isopropyl alcohol and methyl proxytol [19-24]. The cold flow behavior of biodiesel is generally assessed through its PP, CP, and cold filter plugging point (CFPP) [25-26]. These parameters are generally characterized by the temperature in which biodiesel starts to change from fluid to solid state, resulting in performance issues. Biodiesel has start-up and operability problems during cold weather because of its poor cold flow behavior [27-30]

2. COLD FLOW PROPERTIES OF BIODIESEL

Crystallization of the saturated fatty acid during winters causes fuel starvation and operability problems as solidified material clogs to fuel lines and filters. With decrease in temperature, more solid is formed and material approaches the pour point which is the lowest temperature at which it will cease to flow. It has been well established that the presence of higher amount of saturated components increases the cloud point and pour point of biodiesel utilization of additives that enhance the impact of crystal morphology and blending with a fuel like kerosene which causes freezing point depression [31,32].

POUR POINT (PP):

The pour point of a liquid is the lowest temperature at which it becomes semi solid loses its flow characteristics. The oil flow is retarded due to increase in viscosity and formation of wax crystals at low temperatures [33]. Diesel fuel should not lose its flowability especially in cold weather. High pour point can clog the fuel filter in cold weather, causing the engine to stop running [34, 35]. To reduce the pour point of fuel, especially in diesel engines operating in cold regions, certain amounts of kerosene and various chemical additives are added.

CLOUD POINT (CP)

In the petroleum industry, cloud point refers to the temperature below which wax in diesel or biowax in biodiesels forms a cloudy appearance. The presence of solidified waxes thickens the oil and clogs fuel filters and injectors in engines. The wax also accumulates on cold surfaces (producing, for example, pipeline or heat exchanger fouling) and forms an emulsion with water. Therefore, cloud point indicates the tendency of the oil to plug filters or small orifices at cold operating temperatures [33, 34, 36].

COLD FILTER PLUGGING POINT (CFPP)

It is the lowest temperature expressed in degrees Celsius, where a particular type of diesel fuel passes through a standardized filtration device at a certain time when cooled under certain conditions [37, 38]. In other words, cold filter plugging point (CFPP) is the lowest temperature, expressed in degrees Celsius (°C), at which a given volume of diesel type of fuel still passes through a standardized filtration device in a specified time when cooled under certain conditions. This test gives an estimate for the lowest temperature that a fuel will

give trouble free flow in certain fuel systems. This is important as in cold temperate countries, a high cold filter plugging point will clog up vehicle engines more easily [39].

3. MATERIALS AND METHODS

PHYSICAL AND CHEMICAL PROPERTIES OF THE TEST FUELS

The sunflower oil used in the study was obtained from the local commercial market. In order to produce fuel suitable for the standard, Sigma-Aldrich's 99.7% purity methyl alcohol and as a catalyst, Merck brand 99.9% purity potassium hydroxide (KOH) were purchased from commercial companies. The experiments were conducted in accordance with our previous studies and literature information, and 65^{o}C temperature, 60min reaction time, 1% catalyst and 20% of methyl alcohol was determined as optimum conditions, and transesterification reactions of all oils were performed under these conditions. The properties of the biodiesel fuels produced were analyzed in Batman University Technical Sciences Vocational School Refinery and Petro-Chemistry Technology program laboratory. Fuel properties of methyl proxytol-biodiesel blends mixed in different proportions are given in Table 1.

Table 1. Fuel properties of methyl proxtyl-biodiesel blends mixed in different proportions

Fuels	**Density 15^{o}C (kg/m^{3})**	**Kinematic Viscosity 40 ^{o}C(mm/s^{2})**	**Pour Point (^{o}C)**	**Cloud Point (^{o}C)**	**CFPP* (^{o}C)**
Diesel	795	3.20	-22	-6.0	-15
Biodiesel	878	4.25	-9	-3.0	-9
MP**	922	1.32	-78	-68.0	-79
%2 MP	880	4.04	-51	-57.4	-54
%5 MP	882	3.69	-53	-60.2	-56
%7 MP	883	3.48	-57	-63.6	-59

CFPP*: Cold filter plugging point MP: Methyl proxytol**

The fuel properties of biodiesel vary greatly depending on the fatty acid distribution [26]. The most important features are ignition ability, cold flow properties and oxidative stability. Although saturation and fatty acid distribution in lipids do not have a significant effect on the production of biodiesel by the transesterification method, it is directly associated with the properties of the fuel.

4. RESULTS AND DISCUSSION

Viscosity and density are the two physical properties of biodiesel fuels which are more responsible for the engine performance. Both of these parameters are related to combustion process, which is highly dependent on the quality of atomization. In turn, fuel atomization is dependent on fuel properties such as viscosity, surface tension and density. Two factors like

pressure and temperature are dependence of physical properties that affect biodiesel fuel atomization and combustion (viscosity, surface tension, density droplet size in injector). Physical properties of biodiesel are dependent on temperature. Since density is the ratio of mass per unit volume, measuring the variation in volume of a given mass of oil as a function of temperature leads to the density at elevated temperatures. In Figure 1, density and viscosity changes of fuels and blends used in the study are seen.

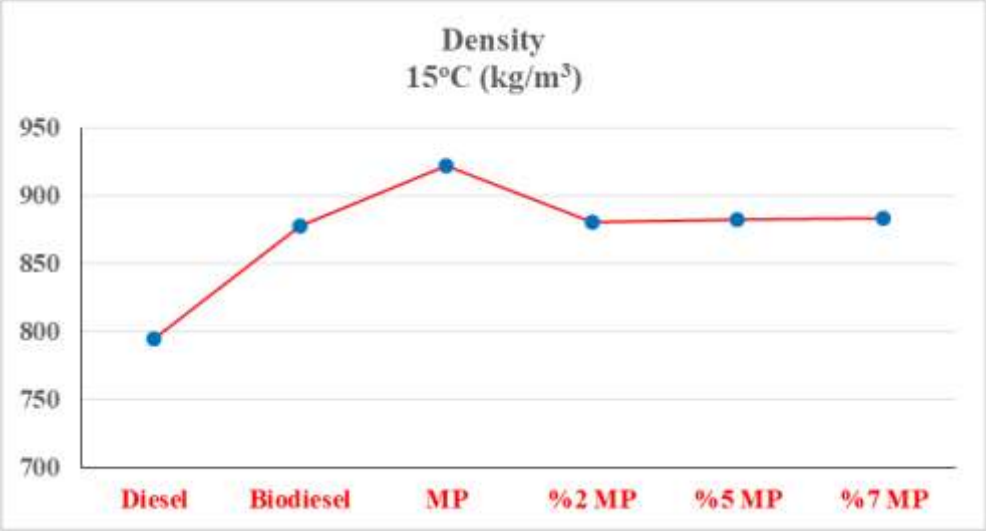

Figure 1. Density changes of fuels and blends

As can be seen in Figure 1, the density of methyl proxytol is higher than normal diesel and biodiesel. Therefore, as the percentage of weight increases in the methyl proxytol fuel mixture, it is seen that the densities formed increase. However, it was determined that all of the results obtained were in compliance with ASTM D6751-12 / EN ISO 12185 standards.

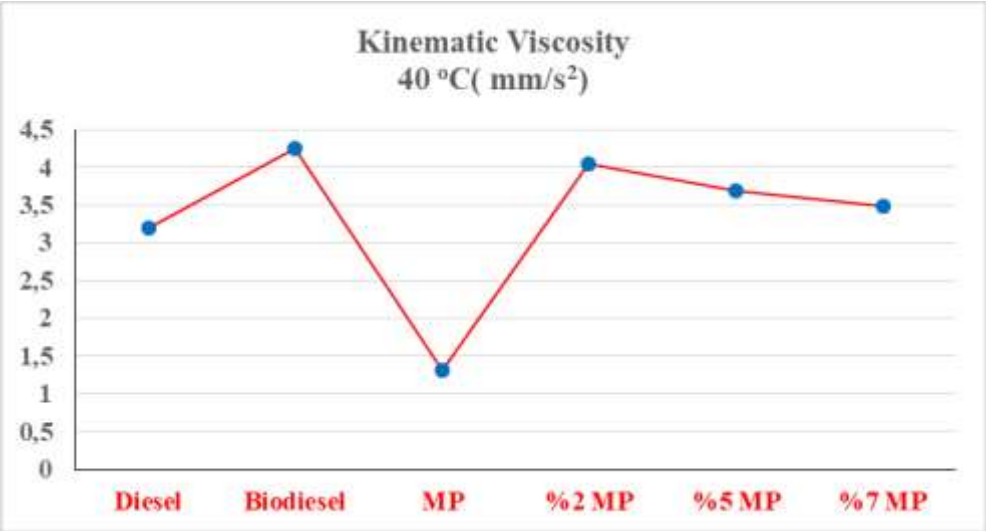

Figure 2. Viscosity changes of fuels and blends

Since the viscosity of the methyl proxytol we use in the study is quite low, it is seen in Figure 2 that the viscosity values of the mixtures decrease significantly when mixed with biodiesel. It is anticipated that fuel mixtures will be transported to the combustion chamber in the engine in a healthier manner. In this study, the main purpose is to improve the cold flow properties of the obtained fuel mixtures by adding methyl proxytol to biodiesel fuel at different rates whose freezing, flowing, clouding and cold filter plugging points are quite low compared to diesel. In Figures 3,4 and 5, the flow, clouding and cold filter plugging points of fuels mixed with biodiesel at different rates can be seen.

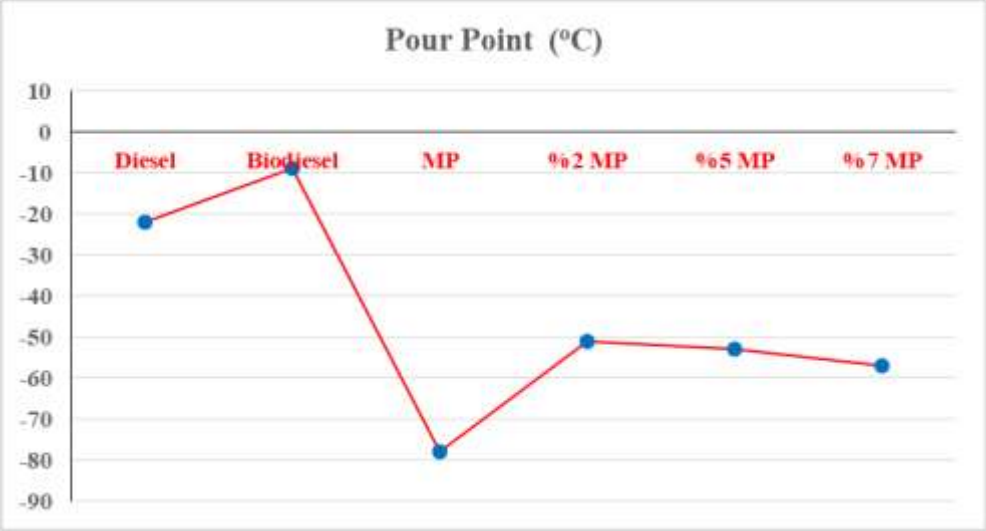

Figure 3. Pour point changes of fuels and blends

Since the pour points of biodiesel are higher than diesel fuel, vehicles running on biodiesel may experience more fuel system plugging problems than petroleum diesel fuel products [40,41]. When Figure 3 is examined, it is observed that the pour points of the fuel mixtures decreased when methyl proxytol, whose pour point is much lower than both normal diesel and biodiesel, is mixed with the biodiesel at certain rates. This is especially important in the use of such a fuel blend, especially in cold climatic conditions, and the fuel system clogging problem will be eliminated.

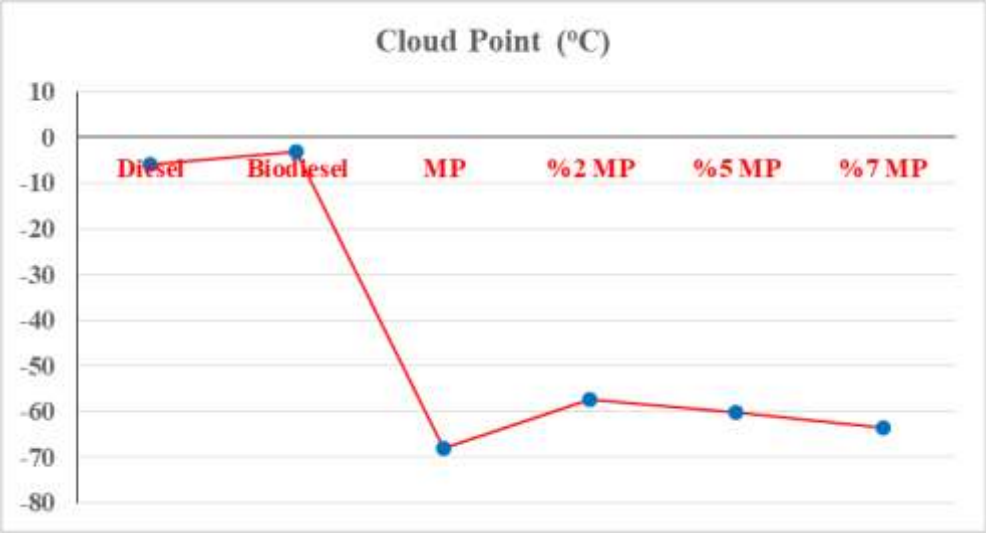

Figure 4. Cloud point changes of fuels and blends

Cloud point is the temperature at which wax (paraffin) begins to separate when oil chilled to a low temperature, and it serves as an important indicator of practical performance in automotive applications in low temperatures [42]. As seen in Figure 4, it is determined that there is a significant decrease in the clouding points of the fuel blends that are formed when the methyl proxytol biodiesel is mixed with different rates at the cloud point compared to diesel and biodiesel. This is thought to have a positive effect on automotive performance at low temperatures.

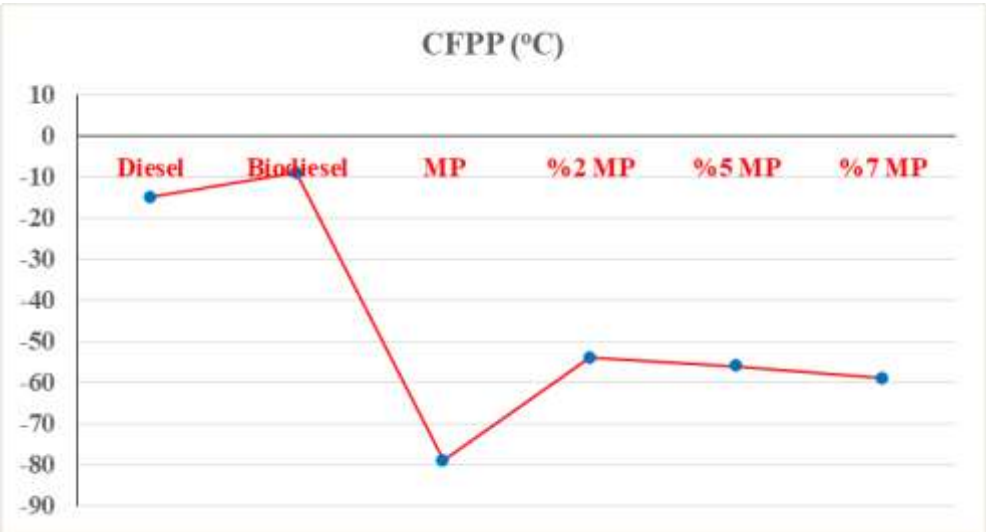

Figure 5. Cloud filter plugging point changes of fuels and blends

Biodiesel like all diesel fuels tends to gel in cold weather, resulting in clogged filters and plugged fuel lines. One of the most important properties for biodiesel is CFPP. It is absolutely undesirable for fuel to gel early in the cold, and clog the fuel filter. When Figure 5 is

examined, it is evident that the CFPP values of the obtained fuel blends, whose CFPP values are quite low, decreased significantly when used with methyl proxytoel biodiesel. Therefore, it is thought that when certain amounts of methyl proxytol are added to the biodiesel in cold climatic conditions, the problem of gelling and blockage of the fuel filter will be eliminated.

5. CONCLUSIONS

The main purpose of this study is to improve the cold flow properties such as pour point, cloud point and CFPP of the fuel mixture obtained by adding 2%, 5% and 7% methyl proxytol to biodiesel fuel. The density and viscosity values of the fuel blends obtained in the study were also compared. Since the density of methyl proxytol is higher than that of normal diesel and biodiesel, it is observed that the density of the blends formed as the percentage of weight of the methyl proxytol increases in fuel mixture (880-883kg/m^3). It was determined that all of the obtained results are in accordance with ASTM D6751-12 / EN ISO 12185 standards. Since the viscosity value of the methyl proxytol (1.32mm^2/s) is very low compared to the biodiesel (4.25mm^2/s), it is observed that the viscosity values (4.04, 3.69 and 3.48 mm^2/s) the fuel blends also significantly decrease. Considering the cold flow properties of fuel mixtures, which are the main purpose of the study, both pour point (-51, -53 and -57^{o}C), cloud point (-57.4, 60.2 and 63.6^{o}C) and CFPP (-54, -56 and -59^{o}C) have decreased. Therefore, when methyl proxytol is added as an additive to the biodiesel, it has been determined that there are significant improvements in viscosity as well as cold flow properties.

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ENERJİ HASAT MAKİNALARI İÇİN KABA CİSİM GÖVDELERİNİN HESAPLAMALI AKIŞKANLAR DİNAMİĞİ ANALİZİ

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ÖZET

Bu çalışmada kaba cisim geometrilerinin hesaplamalı akışkanlar dinamiği analizleri sunulmuştur. Bu gövdeler, akış kaynaklı enerji hasat mekanizmasından toplanan enerji miktarını arttırmak için kullanılır. Enerji verimliliği son yıllarda birçok araştırmacı tarafından çalışılan önemli bir konudur. Enerji hasat makineleri, düşük güç tüketen cihazlar için az miktarda elektrik enerjisi sağlarlar. Elektrik enerjisi, mekanik enerjiden çevrilerek birçok farklı yapıdan toplanabilir. Düşük güç tüketim cihazları, özellikle sensörler, ihtiyaç duydukları enerjiyi kablosuz enerji aktarımı ile elde ederler. Elastik bir kiriş elemanının ucuna bağlı kaba cisim geometrileri ve bu geometrilerin optimum ölçüleri bu çalışmada incelenmiştir. Elastik bir kiriş ucuna bağlanan kaba cisim akış kaynaklı titreşimi arttıracak dolayısı ile elde edilen bu titreşim miktarı kiriş üzerindeki piezo elektrik eleman sayesinde mekanik enerjiden elektrik enerjisine dönüştürülecektir. Literatürde farklı ölçülerde ve geometrik şekilde kaba cisimler kullanılmaktadır. Kullanılan bu yapılar bir ön çalışma olarak optimizasyon sonucu boyut ve şekillerinin belirlenmesi gerekmektedir. Farklı yapıdaki kapalı tip ve açık tip geometriler tasarlanarak hesaplamalı akış analizleri yapılmış ve titreşim oluşmasına sebep kuvvet sonuçları elde edilmiştir. Ayrıca, her bir kaba cisim geometrisi için aerodinamik akış çizgileri verilen sabit rüzgâr hızı için elde edilmiştir.

Anahtar kelimeler: Kaba cisim geometrileri; Enerji toplanması, Hesaplamalı akışkanlar dinamiği.

COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF BLUFF BODIES FOR ENERGY HARVESTERS

ABSTRACT

In this study, computational fluid dynamics analyzes of the bluff geometries are presented. These bodies are used for the increase the amount of energy harvested from the flow-induced energy harvesting mechanism. Energy efficiency is an important issue that has been worked by many researchers in recent years. Energy harvester provides a small amount of electrical energy for low power consuming devices. Electrical energy can be harvested from a lot of different structures by translating mechanical energy. The low power consumption devices, especially the sensors obatin the energy they need by wireless energy transfer. The bluff body geometries attached to the end of an elastic beam element are investigated and the optimum dimension of the geometries is investigated in this study. The bluff body connected to tip of the elastic beam will increase the flow-induced vibration, so this vibration amount will be converted into electrical energy thanks to the piezoelectric element on the beam. Different sizes and geometrically rough bodies are used in the literature. As a preliminary study, these structures should be determined as a result of optimization. Different closed type and open type geometries have been designed and computational flow analyzes have been carried out

and force results that have caused vibration has been obtained. In addition, the streamlines created by the constant given wind speed obtained for each bluff geometry.

Keywords: Bluff bodies; Energy harvesting; Computational fluid dynamics.