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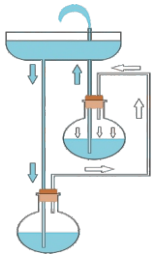

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Editor in Chief:

Dr. Dina Izadi

Physics Education, National Polytechnic Institute, IPN, Mexico
Researcher & President, AYIMI & ADIB
info@ayimi.org

Associated Editors

Dr. Masoud Torabi Azad
Professor, Physical Oceanography, Islamic Azad University
&
Board Member, AYIMI
torabi_us@yahoo.com

Nona Izadipanah
Msc. Geophysics, Islamic Azad University
Scientific Committee &
Board Member, AYIMI
info@ayimi.org

Dr. Cesar Eduardo Mora Ley
Professor, Physics Education, National Polytechnic Institute, IPN, and
CICATA Principal , Mexico
ceml36@gmail.com

Dorna Izadipanah
Msc. Microbiology, Islamic Azad University
Scientific Committee &
Board Member, AYIMI
info@ayimi.org

Dr. Carmen del Pilar Suarez Rodriguez
Faculty Member, Physics Education,
UASLP, Universidad Autónoma
de San Luis Potosí, Mexico
pilar.suarez@uaslp.mx

Designers:

Nona Izadipanah
Dorna Izadipanah

Address:

Unit 14, No.32, Malek Ave., Shariati St.
Post Code: 1565843537
Tel:+9821-77507013, 77522395

http://www.ayimi.org
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Editor in Chief
Dr. Dina Izadi
Researcher & President
AYIMI & ADIB
International Research & Artistic Institutes
http://www.ayimi.org, http://adib.ayimi.org
Email: info@ayimi.org
Unit 14, No. 32, Malek Ave., Shariati St.,
Post Code: 1565843537
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http://journal.ayimi.org
Tehran/ Iran

ART IN SCIENCE EDUCATION

Dina Izadi, Researcher & Director, AYIMI; info@aymi.org

Department of Physics, National Polytechnic Institute, IPN, Mexico City, Mexico

ARTICLE INFO

Full paper : NRC Research Press, Canadian Journal of Physics

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http://www.ayimi.org

ABSTRACT

This published paper in Canadian Journal of Physics has investigated some important views related to STEAM Education .

Combining the arts and standard curricula together can create a richer and more lasting learning experience for students who believe that learning science is boring in classes. It is suggested that study of the arts should be accepted as an essential part of achieving success in work. To this end, the most important action…

Résumé : Combiner les arts et le programme scolaire standard peut créer une expérience plus riche et plus durable pour les étudiants qui croient que l'étude des …

1 Introduction

One of the most important aims of education is to develop more knowledge, skill, and ability. Students of the 21st century are very different from the students of the past. This requires educators to think continuously about how to change their teaching to empower and engage modern students, which makes educational innovation important. Research [1] has shown that what students learn in the arts may help them to master other subjects, such as reading, math or social studies. Students who participate in arts learning experiences often improve their achievement in other realms of learning and life. For example, an analysis [1] of multiple studies confirms the finding that students who take music classes in high school are more likely to score higher on standardized mathematics tests. One explanation is that musical training in rhythm emphasizes proportion, patterns, and ratios expressed as
mathematical...

- Finding the nexus of arts and sciences in our everyday life

In our society, those who have been educated in different universities and different sciences cannot easily communicate with each other on their subject, and the schism between the sciences and the arts is the main reason. Climate change and its effects have severe consequences for our environment, so reducing energy
use in buildings is one of the most important ways to reduce humans' overall environmental impact. There are several elements to the design of buildings, and architects should consider the use of more sustainable materials. By considering several parameters, such as weather and culture, an analysis of every step in the construction of a building, from the paints used on the walls to the type of ventilation system, give a clearer picture of how architects can design the best building.

Our ancestors, by studying the environment, identified the principles of geometry, the physics of forces, and its mechanisms to build their buildings using

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The Intelligent Diagnosis and Treatment of Postural Deformities by Analyzing the Given Data from Kinect Camera

SeyedehSara Jalilishani, Farzanegan 3 High School, sarajalili33@gmail.com

ARTICLE INFO

Winner of Gold Medal, ICYS 2018, Belgrade, Serbia
Accepted in STEM Fellowship Canadian Journal
Supervisor: Hossein Azizinaghsh
Accepted in country selection by Ariaian
Young Innovative Minds Institute,
AYIMI,
http://www.ayimi.org , info@ayimi.org

ABSTRACT

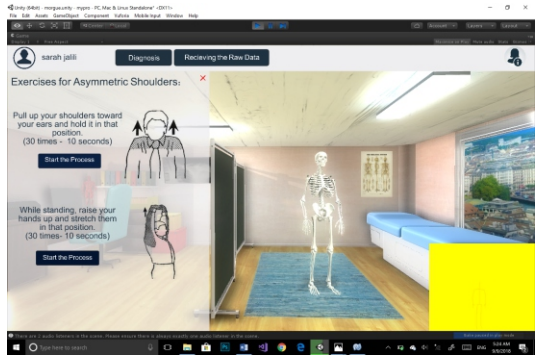
Postural deformities are common abnormalities related to the skeleton form, with growing prevalence among people. In the constructed system we have created a method by which any individual can diagnose and treat their postural deformities intelligently with the least requirement of an orthopedic doctor's supervision.

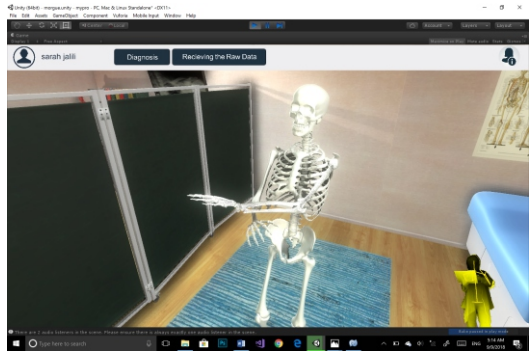
1 Introduction

In the implementation of the project we used Kinect camera, a gaming device provided by Microsoft company, because it has functional features with a reasonable price. The Kinect camera is capable of body tracking, joint coordinating and motion capturing. If the user stands in the proper distance from the camera, the system receives some data from the user's body, analyzing this data, we could implement the diagnosis phase. The treatment of the deformities is defined in the form of different exercises according to the medical references, having these exercises and knowing that Kinect camera is capable of motion capturing, we could guide and monitor the user during the treatment phase. After the enhancement made on the system the accuracy of the whole system was calculated, the results showed that the system provides enough validity for this purpose. This system can be used instead of a doctor in schools and clinics and any places with large number of users, to save money and also the accelerating the amelioration process.

2 Creating a profile for the patient

Before entering the program users will go through a profiling process in which some personal information will be received from them and will be held in a profile with a profile number that will be also provided for the users. As the profile is created an email will be send to the patient's doctor so that the doctor would have access .....





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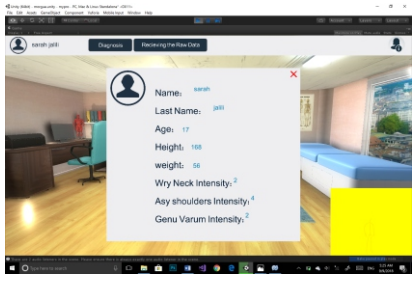
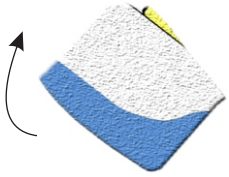


SCIENTIFIC RESEARCH ON WATER BOTTLE FLIPPING

Kiana Ashouri, Farzanegan 7High School, kiana.ashouri@gamil.com

ARTICLE INFO



Winner of Bronze medal in ICYS 2018, Belgrade, Serbia

Supervisor: Dr. Hossein Salari

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

The current craze of water bottle flipping is a problem of the 31th International Young Physicists' Tournament, involves launching a partially filled plastic bottle into the air so that it performs a somersault before landing on a horizontal surface in a stable, upright position. First the important role of some physical rules were investigated and then according to the theories the existence of some factors which were related to our theories was predicted. Second this flipping with different percentages of water filled was done to compare the best and worst given results together and the purpose of this comparison was to ensure whether our theory in a successful flipping was correct or not and could we explain this phenomenon correctly.

1 Introduction

In 2016, a viral video of a teenager, Michael Senatore, flipping a water bottle at a talent show at Ardrey Kell High School in Charlotte, North Carolina popularized the activity. Senatore had started flipping water bottles the year prior in his chemistry class, and mastered the trick. After his performance, the recorded video became a viral success; the trend spread across the rest of the world, and is still being done as of 2018 [1].

In the first sight we saw the rotation of the bottle similar to the rotation of the badminton ball in the air or diving of a person (Fig. 1).

Fig. 1: The rotation of the bottle

But the remarkable thing we missed was that all of those examples are rigid body while the water inside the bottle turns our object into nonrigid body and definitely the movement of the water causes a lot of changes, including the changes of center of mass or the sloshing of the water will redistribute the mass along the bottle and the changes of the moment of inertia. As a result, that water sloshing has important role in a successful landing, but we don't know how it can affect on the bottle's velocity? How we can explain and investigate the water sloshing while it is complex phenomenon? What are some other effective parameters? What is the optimal filling fraction and why?

2 Theory & Modeling

2-1 Sloshing

The sloshing of the water is one of the effective parameters in lowering the bottle's velocity itself and on the other hand it leads to a redistribution of the mass along the bottle that will increase the moment of inertia which is the second parameter [2]. Sloshing will take the kinetic energy in so far as the bottle will lose its velocity [Eq. 1].

$$K_\omega = \frac{1}{2} I\omega^2 \qquad (1)$$

where I is the moment of inertia and ω is angular velocity.

Since sloshing is complicated subject in physic, the changing of center of mass was spotted as a sign which shows the existence of sloshing in the phenomenon.

2-2 The moment of inertia

We know the fact that bottle's angular momentum must be conserved. For a rigid body, the conversation of angular momentum implies a rotation with constant angular velocity making a smooth landing rather unlikely, but in our nonrigid body the redistribution of the mass along the bottle will increase the moment of inertia and then the angular momentum implies a decrease of rotational velocity leaving the impression of the bottle being suspended horizontally in the air for a moment. Then the bottle will fall slowly and land upright.

To explain it from the other side which is easier, the angular momentum can be assumed constant because gravity force is applied to the body and by this assumption the moment of inertia will decrease the angular velocity.

$$L = I\omega \qquad (2)$$

2-3 Center of mass

The center of mass in a system is the point that moves as though all of the system's mass were concentrated there

and all external forces were applied there [3].

$$x_{cm} = \frac{\sum_{i=0}^{n} m_i x_i}{M} \quad (3)$$

$$x_{cm} = \frac{1}{M}\int x\, dm \quad (4)$$

2-4 Angular momentum

Angular momentum is the quantity of a rotating body which is a product of angular velocity and the moment of inertia. Since there is only gravity force which is applied to our body we assumed that there is no external force and according to Newton's second law in angular form which is "If no net external torque acts on the system, this equation becomes :

$$d\vec{L}/dt = 0$$

so angular momentum would be constant.

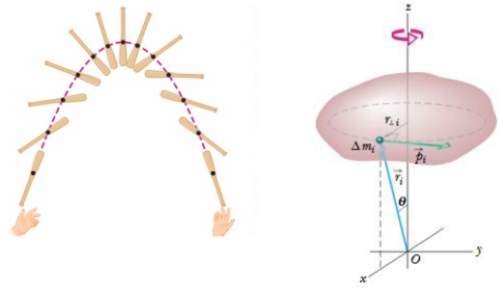


Fig. 2: Angular momentum

2-5 The moment of inertia

The moment of inertia tells us how the mass of the rotating body is distributed about its axis of rotation [3].

$$I = Mr^2 \quad (5)$$

Where, M is the total mass of the body, and r is a radius from the central axis to a particle.

This is used for calculating the moment of inertia for the Object which is about central axis, but since our body is not rotating around its center of mass point we considered that the bottle is about axis which is parallel to the axis through the center of mass and we used parallel axis theorem to calculate the bodv's moment of inertia.

$$I = I_{com} + Md^2 \quad (6)$$

Where, I_{com} is a moment of inertia of a body which is about an axis through the center of mass point , M is total mass of our body, and d is the distance between axis through the center of mass and axis which is parallel to central axis.

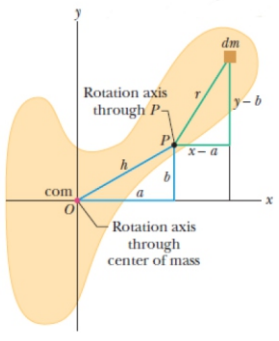


Fig. 3: A rigid body in cross section, with its center of mass at *O*.

The parallel-axis theorem (Eq.6) relates the rotational inertia of the body about an axis through *O* to that about a parallel axis through a point such as *P*, distance *h* from the body's center of mass. Both axes are perpendicular to the plane of the figure [3].

3 Experiments

Our whole system is separated into two parts :

1. Empty bottle that its center of mass is located at $H/2$

2. Water that its center of mass is located at $h/2$ (when the bottle is self centered and all of the water is at the bottom of the bottle).

By this assumption we approximately could understand the total body's center of mass's position which is shown as h_{cm} in Fig. (4). Notable point is that the water will distribute along the bottle and as a result the height of the water varies from its minimum h_0 to maximum value located H (when water is distributed through the bottle completely) as shown in Fig. 4 The center of mass can be found by Eq.(7) .

$$h_{cm} = \frac{\frac{H}{2}m_b + \frac{h}{2}m_w}{m_b + m_w} = \frac{H}{2}\left(\frac{m_b + m_w\frac{h}{H}}{m_b + m_w}\right) \quad (7)$$

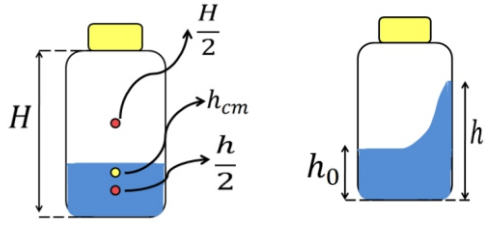


Fig. 4: h is the height of the water which varies with time

According to water's height changes the total center of mass varies and the maximum sloshing can happen when the center of mass reaches the $H/2$ from h_{0cm}.

$$h^0_{cm} = H/2\left(\frac{m_b + m_w h_0/H}{m_b + m_w}\right) \quad (8)$$

By considering the bottle as a cylinder, the total moment of inertia yields us Eq. (9-11).

$$I_b = I_0 + m_b\left(\frac{H}{2} - h_{cm}\right)^2 \quad (9)$$

$$I_w = \frac{1}{12}m_w h^2 + m_w\left(\frac{h}{2} - h_{cm}\right)^2 \quad (10)$$

$$I = \frac{1}{12}(m_w h^2 + m_b H^2) + m_w\left(\frac{h}{2} - h_{cm}\right)^2 + m_b\left(\frac{H}{2} - h_{cm}\right)^2 \quad (11)$$

In last step by considering the angular momentum constant we come to this conclusion that angular frequency can be expressed as

$$\frac{\omega(t)}{\omega_0} = \frac{I_0}{I(h)} \quad (12)$$

where $I(h)$ is given by Eq.(11) and is the initial angular velocity and I_0 is initial moment of inertia when we have the minimum height of water h_0.

According to the distribution of the mass along the bottle we knew that the moment of inertia will increase and certainly the angular velocity will decrease and this

changing in angular velocity can be inferred as a sign of losing velocity in bottle. For further explanation, when ω is equal to zero, means that two consecutive angle are equal to each other or on the other hand the object has lost its velocity.

By using all these facts ω_0 should reduce ω as much as possible so we should look for the minimum of the ratio $I_0/I(h)$ which can obtained when maximum $I(h)$ is attained, and for each filling fraction $f = h_0/H$ the maximum moment of inertia is attained when water is maximally distributed along bottle and $h = H$ [2] . Therefore, we should look for the value of f for I_0/I_{max} .

For finding the I_0/I_{max} we can use more analytical form which first needs to determine the mass ratio.

$$M = \frac{m_{w,max}}{m_b} \tag{13}$$

Where $m_{w,max}$ is the water mass for a filled bottle. With this, the mass of the water can be defined as $m_w = f m_{w,max} = fMm_b$

$$\frac{I_0}{I_{max}} = \frac{M^2f^4+4Mf^3-6Mf^2+4Mf+1}{(1+Mf)^2} \tag{14}$$

According to the effective role water sloshing has in the phenomenon, the minimum value of h_{cm}/H can be the sign of maximum changing of the center of mass or on the other hand maximum water sloshing. Again we can find better and more analytical form for finding instead of expression (7) by introducing the mass ratio.

$$\frac{h_{cm}}{H} = \frac{1}{2}\left(\frac{1+Mf^2}{1+Mf}\right) \tag{15}$$

At last we come to conclusion that optimal filling fraction should include the minimum of I_0/I_{max} and also minimum of h_{cm}/H

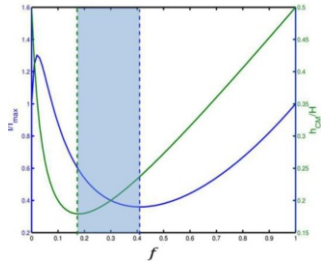


Fig.5: Two green and blue curves are h_{cm}/H and , I_0/I_{max} respectively

The relation between the changing of center of mass and the moment of inertia are shown in Fig. (5) for:

$M = m_{w,max}/m_b = 20.$

As shown in Fig.5 the minimum of h_{cm}/H is in f=0.18 and the minimum of I_0/I_{max} is in f=0.41 , then we can determine the optimal range which is approximately from 20% to 40% of water filled and it is shown as the blue zone in Fig. (5) [2].

4 Results

1- This flipping was done about 120 times with 5%, 20%, 30%, 33%, 40%, 50%, 60%, and 70% of water filled. The best given result was 33% (a) and the worst were 5% (b) and 70% of water filled. Then the angular velocity was calculated by measuring the angles of the bottle in 22 frames and then the changing of angular velocity was investigated to figure out whether it will be equal to zero or not in 33% as the optimal filling fraction.

2- In the first step our optimal range in experiment was compared with theory and the best range is from f=0.18 to f=0.4 which is shown as the blue zone in Fig. (6).

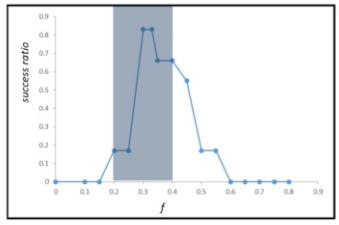


Fig.6: Success ratio in flipping water bottle

3-The next result was about water sloshing and obvious distribution of water along the bottle.

Fig.7: Sloshing in flipping water bottle

4- Decreasing of angular velocity was other result in our experiments which is shown in Fig. (8).

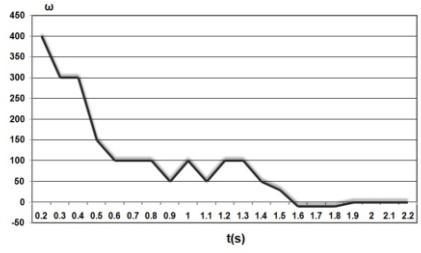
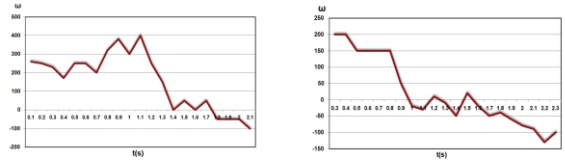


Fig.8: Angular velocity vs. time in flipping water bottle

The angular velocity for 5% (a) and 70% (b) of water filled was measured to find if it decreases or not .



(a) (b)

Fig.9: Angular velocity vs. time in 5% (a) and 70% (b)

5 Conclusion

1-The water sloshing which can defined by changing of the center of mass and the moment of inertia are two effective factors which make the bottle lose its velocity.

First, sloshing will take some rotational energy. second, because of the water sloshing we will have the redistribution of mass along the bottle which increases the moment of inertia, and third since the angular momentum must be conserved during the flipping, the increasing of the moment of inertia will decrease the angular velocity that its decreasing will be expressed as a sign of lowering of velocity which means that bottle will being suspended horizontally in the air for a moment. When performed successfully, the flip ends with a nearly vertical descent

that is followed by a smooth landing [2].

2-The optimal range of filling fraction is from 18% to 41% and the optimal single filling fraction is 33% which includes a low value of I_0/I_{max} and h_{cm}/H.

3- The angle of the wrist and hand, the acceleration is given to the bottle, the bottle's shape and volume, the viscosity of the liquid, and etc. are other effective factors in this phenomenon which were considered constant in our experiments.

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MANUFACTURING A LIGHTWEIGHT CONCRETE BY USING FOOD WASTE

[a]Seyedeh Sara Shams , [b]Zahra Nasiri

a) & b) Farzanegan 1 High School, Tehran/Iran, a) s_sarashams@yahoo.com, b) zahranasirii@yahoo.com

ARTICLE INFO

Winner of Silver medal in ICYS 2018, Belgrade, Serbia

Supervisor: Matine Jalaeian

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

Lightweight concrete in building construction is important hence according to this research, egg and walnut shells and nano-cellulose were selected as hardening and lightening materials in cement substitutes. Walnut shell has cellulose structure in its cell wall and egg shell has sustainability, high level of renewable and environmentally friendly raw materials which show some new features in nano dimensions.

1 Introduction

Today, the use of lightweight concrete in building construction is becoming increasingly important[1][2]. Furthermore, the use of environmentally friendly materials is one of the new approach applied by engineers[3]. Hence, our research team used natural wastes in concrete construction[4]. According to studies, egg shell, walnut shell and nano-cellulose were selected as hardening and lightening materials and separately tested as cement substitutes[5].

As is unfortunately the case, the earthquake does cause thousands of deaths worldwide every year. Since the earthquake damages are mostly originated from building destructions, the use of lighter but stronger materials appears to reduce the rate of fatality and injuries caused by building disintegration [6][7].To this end, the concrete materials and components are appreciated as the most widely used constituents in the construction industries. In general, the concrete is referred to as any substance or composition which is composed of a cementitious adhesive. It may be made of various types of cement, as well as Pozzolans, Slag, Furnaces' Dusts, Sulfur, Polymers, Fibers, and so on. Furthermore, to modify and obtain the required properties, some specific additives are also added [8].

Lightening any of the aforementioned crucial parts and materials without sacrificing the strength has been the subject of tremendous previous studies[9]. Accordingly, researchers have attempted to utilize the resulting waste materials such as oil palm shell, palm oil clinker, and coconut shell as lightweight aggregate to produce structural lightweight concrete grade. In this respect, the wood wastes, as coarse aggregates, were also used in producing a special concrete grade holding higher compressive strength. In similar attempt, Hwang et al. developed a light weight concrete by using sewage sludge and glass waste. In 2016, Srivastava *et al.*, studied the suitability of ceramic and plastic wastes as possible substitutes for conventional coarse aggregates in producing the lightweight concrete. To generate lightweight concrete by adding the waste expanded polypropylene-based aggregates was also explored by Martina Záleská *et al*., in 2018. As the approach to produce the lightweight concretes is an endless process, the present work was conducted to examine some new additives to concrete in order to assist the construction industries in reducing the cost but still boasting a high enough strength.

2 Materials and Methods

2-1 Materials

In the present work, different materials such as gravel (sand of Zagros mountain ,Nemati brothers production factory, size 06), cement (Saruj company ,type1.425), two different sizes of egg shell (under and on mesh 200), walnut shell, Nano-cellulose, tap water, Lubricants (Kimiya Plast 101), lightweight P1, P2 (two natural gums) and E600 (lightweight filler) were examined. In addition, 5*5 molds, metal tray, track, scales (with 0.1g accuracy), graded cylinder, metal spoon, knuckle, concrete breaker (EG & G Chandler's 4207 compacting density tester is an automatic electric hydraulic press which includes a 5-inch diameter cylinder, that applies a force of about 40,000 pounds to a welded steel plate) water bath, 3 different sizes of sieves (3.8 ,4,16), micrometer, and wooden rod were utilized to prepare the samples.

2-2 Experiments and procedures

In order to make the desired samples, the raw materials were accurately measured by a precise scale for each sample separately in 270C(table 2). In the next step, tap water was added gradually to achieve a homogeneous mixture. Then, the mixture was poured in the molds in a uniform shape with 5 cm side during three stages. After each stage, 25 beats were hit until the mixture was completely compressed. After three days, the samples were dried and taken out of the molds. In the last step, they were placed in a water bath for one week to dissolve the sample lime in water. After taking the samples out of the water bath, they were sent to the laboratory for pressure test and density calculation.

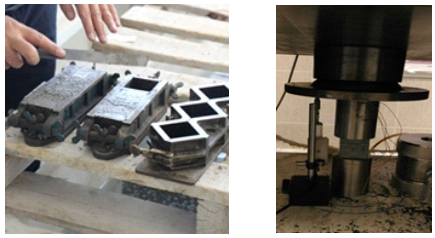

Fig. 1: samples and procedures

3 Results and Discussion

After comparing the compressive strength of the samples with each other and with the reference sample, it can be concluded that the addition of egg shells to the concrete components makes the concrete lighter and stronger by decreasing the amount of concrete cement. This can be related to the mineral structure of egg shell. Nano cellulose was used because this material showed some new features in nano dimensions. Walnut shell was used because it has cellulose structure in its cell wall. The egg shell possessed silica, as well as sand and calcium carbonate, which had a calcareous effect. The reason for the obtained concrete strengthening is related to the bonding produced from the combination of calcium carbonate and silica. This in fact produces a substance called calcium silicate (CaSiO3). This is the same material that strengthens the glasses.

According to the results obtained from the second steps, the smaller size of the egg shells led to the samples with higher strength and higher density. Besides, employing more egg shells reduced the density. The size of utilized sand was also an important factor. The smaller sand size resulted in lower density. Water consumption was another factor affecting the strength of concrete. According to the results of this work, as the amount of consumed water was increased, the sample compressive strength was raised but the density was decreased .Furthermore, two natural gums (P1 and P2) and E600 lightweight filler were used. P1 and P2 could condense the mixture and capture the air bubbles from the samples. These additives greatly reduced the density, but the samples strength were reduced due to the formation of air bubble. The results are summarized in table (1).

Table 1: The components in our samples

Component	Sand (gram)	Cement (gram)	Distilled Water (gram)	Egg shell (gram)	Walnut shell (gram)	Nano Cellulose (gram)	Compressiv pressure(KN
Index (W)	70	10	20	-	-	-	4.0
X	70	5	20	5			4.50
Y	70	5	20	-	5	-	0.5
Z	70	5	20	-	-	5	2.15

The best combination in this project was sample B with 7% egg shell replacement instead of cement by passing 200mesh.

The optimum properties were achieved in the sample which had 7% lower cement than the reference one, tits egg shells were passed from 200 mesh, and 12% water in its total mass. This sample could show the stability of 8500 kg, which was 1400 kg more than the reference sample and therefore could tolerate the weight of 6 cars. Its density was 2.22 g / cm3, which was 0.15 g/ cm3 lower than the reference sample. It is worth considering that the results obtained from the compressive strength are related to 6-days concrete, but usually the concrete used in constructions is 28-day concrete. There are many ways to convert this number which differs based on the temperature conditions and ingredients.

By placing the strength of the sample B in the formula, the strength of the concrete will be 499.9 kg/cm2 due to increasing the strong over time. The density and the compressive strength of samples has been shown in figures (2a-d).

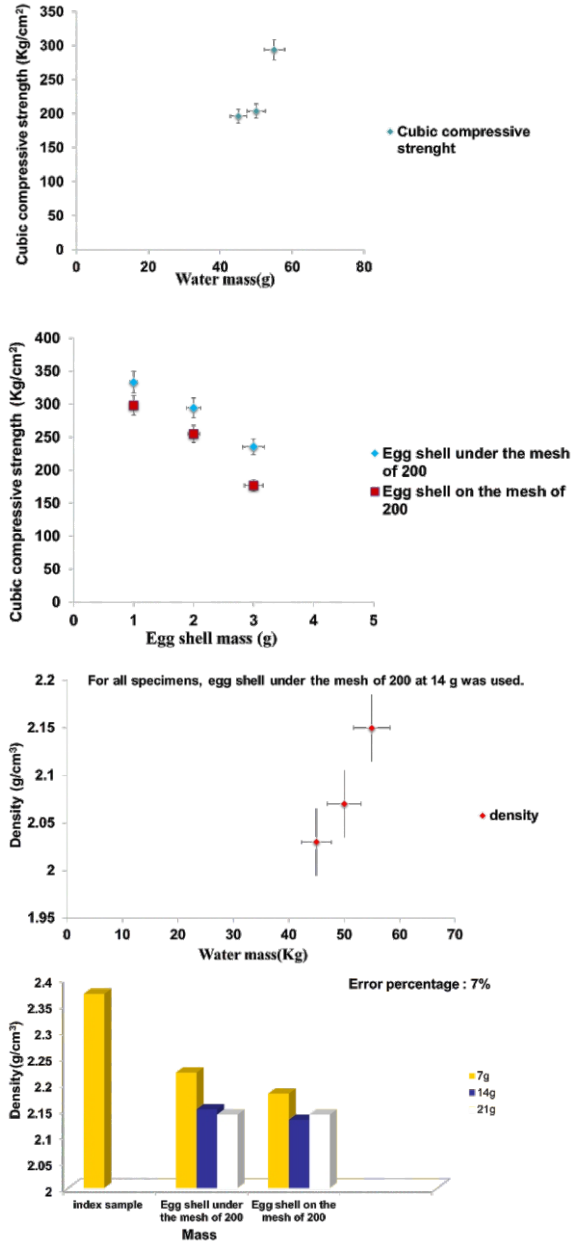

Fig. 2:compress strength and density of samples

Acknowledgment

We would like to thank from our parents and Dr. Abbas Zare Henzaki for their great supports.

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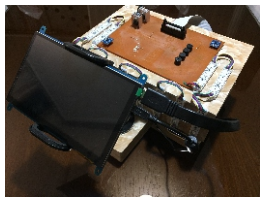
ELECTRICAL PORTABLE SEISMOGRAPH (EPS)

Mahyar Salamati, Kamal High School, Tehran/Iran, m.salamati2015@gmail.com

ARTICLE INFO



Winner of Silver medal in IYSIE 2018, Malaysia

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

A seismometer is an instrument that measures motion of the ground, caused by, for example, an earthquake or a volcanic eruption. The data that is recorded by a seismometer are plotted by a seismograph. “EPS” as a portable seismograph and also a seismometer works by using electrical methods with some unique systems which make it different from others, such as earthquake prediction, Smart alert, online network, auto upgrade and online recording systems. By using physics laws the data are analyzed then it can help geological centers by network connections.

1 Introduction

“EPS” –Electrical Portable Seismograph- consists of some electrical components that help it to receive different data about earthquake and analyze them for geological centers and usual people (Fig.1). It is user-friendly, so can be used by the majority of people. “EPS” has many methods to use it in different situations such as home scale or national and international scales, also because of using electromagnetism receiver plates it can predict earthquake and by its smart alert system, alerts people and geological centers.

Fig. 1: Electrical Portable Seismograph, EPS

2 Materials

Items that are used in EPS:

- •ATMEGA 2560
- •Raspberry PI 3 Model B
- •7" LCD
- •ADXL335 –acceleration sensor-
- •LEDs (RED, Yellow and Green)
- •Buzzer
- •High and Low weight plate
- •Spring in 2 sizes
- •2*8 LCD
- •Main board

3 How does EPS work

As the figures show, EPS has four ADXL335 that are connected to first plate using small springs, then sensors are connected to microcontroller, ATMEGA 2560, to receive the pulse of the sensors and sense the vibration and record the data. It has a module includes a buzzer and LED's that each color of LED shows a range of vibration (1-3 R: Green, 3-5 R: Yellow, 5<: Red). This module is being controlled by the microcontroller, after that data are sent to a Raspberry PI 3 to be analyzed and the graph will be shown by using main LCD. Also Raspberry PI 3 can be connected to internet and share all data and graph on the net and make whole system online that help EPS to alert all people especially the people nearby to save their life.

4 Smart Alert System (SAS)

EPS supports a smart alert system; consisting of some different parts. EPS can automatically diagnose what range the magnitude is to alert people and due to the magnitude EPS uses LED (Blue, Green and Red), Sound waves, app notification on mobile phones and online alert system. The algorithm works in a way that makes EPS to alert people and geological centers for all ground's movements and records data for more information. Here is the algorithm of the SAS (Fig. 2).

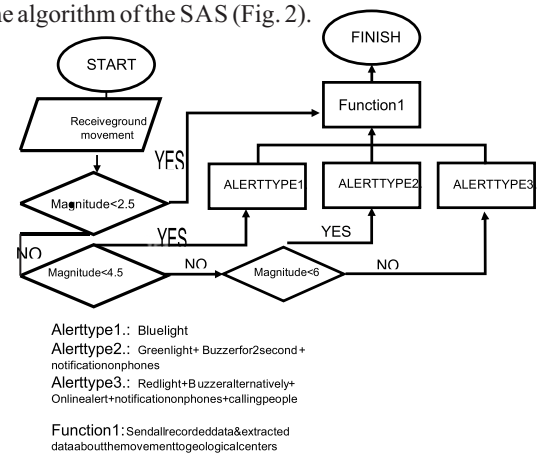


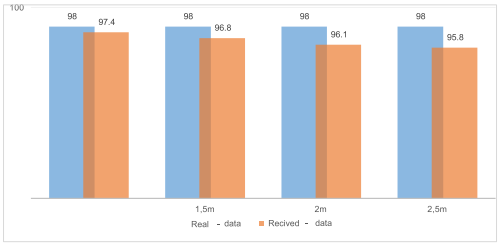
Fig. 2: The algorithm of the SAS

5 Experiments and Results

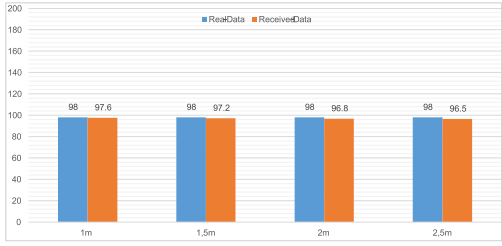
Ground movements in an earthquake has three different directions and each of them has an important role in seismic information. EPS can extract these data and plot the graphs in each direction separately. Different experiments have been done to record data and analyze them by EPS.

5-1 Released Energy

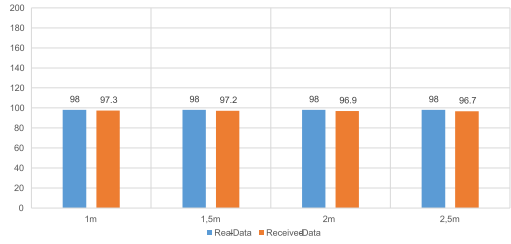
Released energy has been recorded by dropping a 5-kg block from different distances on different floors by EPS and using formulas and the comparison between them –real data and recorded data by EPS- can show us the accurate of Electrical Portable Seismograph (Fig.3 a-c).



(a)



(b)



(c)

Fig. 3: Released energy comparison of real data and recorded data by EPS, a) wooden floor, b) Metallic floor, C) Rocky floor

5-2 Spring's Length

Changing the spring's length can transfer the energy from earth to EPS so for each device, using a special spring can transfer and amplify energy of the movement more accurately.

5-3 The plates

MDF plates in this device has an important role, so physical properties of the plates such as weight, size, thickness and springs' attachment place, and also how much the plate is sticky, are the important factors to support weight in this experiment.

6 Conclusion

EPS has the best function when is used in a large-scale, then it can specify the earthquake focal point just after the vibration. Then the network system in EPS helps it to improve itself automatically. EPS can find an algorithm about the earthquake history and the ground movement in years too.

Effective variables on EPS accuracy are as follow:

-Diameter Of spring

-spring length

-Sensor sensitivity

-Support weight

-Number of springs

- Conductivity of wires

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HERON FOUNTAIN AS A HYDRAULIC MACHINE

Romina SafariFarzanegan7 High School, Tehran/Iran, romi.safari@gmail.com

ARTICLE INFO

Winner of Bronze medal in IYSIE 2018, Malaysia

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

In these days that many of resources on earth are draining , people are likely to hang on all the activities they have done before but nowadays we should endeavor for having better life without any harms on earth. One way is to use the equipment which can help us having enjoyable and desirable sweat life besides using resources in a rational way! In many years ago a physicist, Heron of Alexandria designed a fountain which worked without any external forces and just with three water containers and connecting tubes .The system can pump out the water by the inner forces and the pressure of the water in the system. The parameters which can affect on the water jet in this system have been studied in this research.

1 Introduction

Heron Fountain, designed by Heron of Alexandria, is a hydraulic machine that works with the differences of energies for its own construct. It contains three different containers that each of them contains air & water that pressure changes , can help the water moves in the system. Water is poured in the first container (the upper one is called Basin), moves to the second container (the lowest one, as the air and water supply), because of the energy differences . Then by moving the water downward, the air in the air supply moves to the third and last container (the middle one) that should have enough water for the water jet. So the duration of the jet depends on the amount of the water in this container because of that we call it water supply. The air coming from the air supply to the water supply, will press the water inside the water supply and by that pressure, the water jet goes out (Fig. 1).

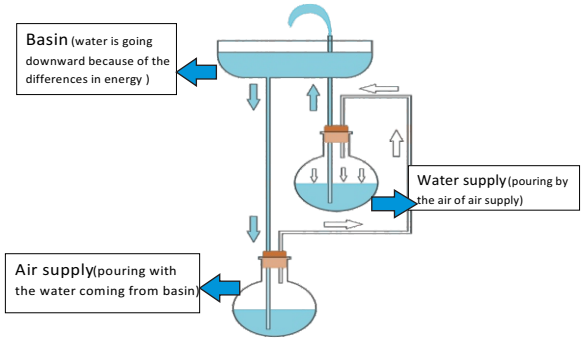

Fig. 1: Heron Fountain

2 Theories

The theories are used for this problem give us all the changes in energies or forces to predict what will happen in this system.

2-1 Bernoulli's Equation and Pascal's Law

In fluid dynamics, Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy; although Bernoulli deduced that pressure decreases when the flow speed increases (Fig. 1). The principle is only applicable for : when the effects of irreversible processes (like turbulence) and non-adiabatic processes (e.g. heat radiation) are small and can be neglected. The simple form of Bernoulli's equation is valid for incompressible flows (e.g. most liquid flows and gases moving at low Mach number). More advanced forms may be applied to compressible flows at higher Mach numbers.

$$p_{atm} + \frac{\rho {v_1}^2}{2} + \rho g h_1 = p_{atm} + \frac{\rho {v_2}^2}{2} + \rho g h_2 \qquad (1)$$

To find the pressure differences in each two points pascal's law is used.

$$\Delta P = P_2\text{-}P_1 = \rho g h_2\text{-}\rho g h_1 = \rho g (h_2\text{-}h_1) \qquad (2)$$

2-2 Flow rate and Bernoulli's Equation

In fluid dynamics, Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in pressure or a decrease in the fluid's potential energy;[1,2]. Although Bernoulli deduced that pressure decreases when the flow speed increases [3,4]. The principle is only applicable for isentropic flows: when the effects of irreversible processes (like turbulence) and non-adiabatic processes (e.g. heat radiation) are small and can be neglected. The simple form of Bernoulli's equation is valid for incompressible flows (e.g. most liquid flows and gases moving at low Mach number). More advanced forms may be applied to compressible flows at higher Mach numbers.

In physics and engineering, in particular fluid dynamics the volume flow rate is the volume of fluid which passes per unit time; usually represented by the symbol Q (m^3/s) . The changes in volume flowing through the area would be zero for steady flow too [5].

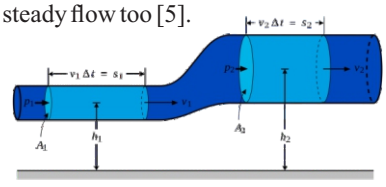

Fig. 2: Pascal's and Bernoulli's principles , flow rate comparison in different volumes

3 Materials & Methods

Here is a list of the materials have been used in our heron's fountain experiments:
- Two isolated plastic bottles as containers
- Isolated tubes for connecting different containers to each other for passing fluids (water& air)
- The plastic bowl used for the basin
- Stands for holding each container in different heights

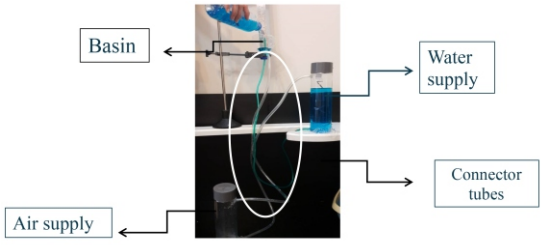

Fig. 3: Heron Fountain setup

At the first step, the water in the basin will comes down to the air supply because of the pressure differences based on the air pressure and water pressure:

$$p_{air} = p_0 + \rho g h_1 \quad (3)$$

After the downward movement of basin's water, we have some changes in the pressure of the air inside the water and air supplies. Based on the explained theories the air and water pressure in water supply can be calculated.

$$p_{water} = p_0 + \rho g h_2 \quad (4)$$

By transferring the air and increasing pressure inside the water supply, the water jet goes out.

$$\Delta p = p_{air} - p_{water} = \rho g (h_1 - h_2) \quad (5)$$

The height of the jet is found according to the flow rate and the pressure difference inside the tube that the water goes out from. Hagen-Poiseuille equation is used, which is about the incompressible and Newtonian fluid in laminar flow through a long cylindrical tube in a constant cross section A.

$$Q = \frac{\rho A^2}{8\pi\mu L}\Delta p \quad (6)$$

In this equation, μ is the viscosity of the fluid and L is the length of the tube . As we know the low viscosity and a wide-short pipe, are for turbulent flows so the Bernoulli's principle is used too.
then by Hagen's & Bernoulli's we got:

$$Q = \sqrt{2\rho} A \sqrt{\Delta P} \quad (7)$$

$$Q = c(\Delta P)^n \quad (8)$$

where c is constant and describes the fluid conductivity of the tube. c & n are given by experiments which n=1 in Hagen's and n=0.5 in Bernoulli's .
Now, from the equation for pressure differences and the flow rate , the flow rate inside the tube is given:

$$Q = c(\rho g (h_1 - h_2))^n \quad (9)$$

$$Q = \rho A v \quad (10)$$

$$v = \frac{c}{\rho A}(\rho g (h_1 - h_2))^n \quad (11)$$

Because of the conservation of energy in our system, the height of the fountain can be calculated by:

$$\frac{1}{2}mv^2 = mgH \rightarrow H = \frac{v^2}{2g} \quad (12)$$

Then the height of the fountain which depends on the conductivity of tube, c, is found . As the value of c is a complex subordinate of A , L , ρ , μ so the relations between H and these parameters cannot be found easily.

$$H = \frac{c^2 g^{2n-1}}{2\rho^{2-2n} A^2}(h_1 - h_2)^{2n} \quad (13)$$

4 Experiments& Results

Investigating the influence of some important parameters in our system shows:
- Changing the temperature of water will have some effects on the result of water jet.
- Changing the height between air & water supplies probably can change the pressure of the pumping water.
- Different diameters of tubes can cause some changes in the results because by changing the diameter, the existing pressure on water will change too.

4-1 Temperature

Changing the temperature of a liquid, will change the movements of the molecules too. Making temperature high, it will exacerbate the movements and lower temperature, will weaken the motion of molecules. These changes can affect on forces that are applied on the liquid.

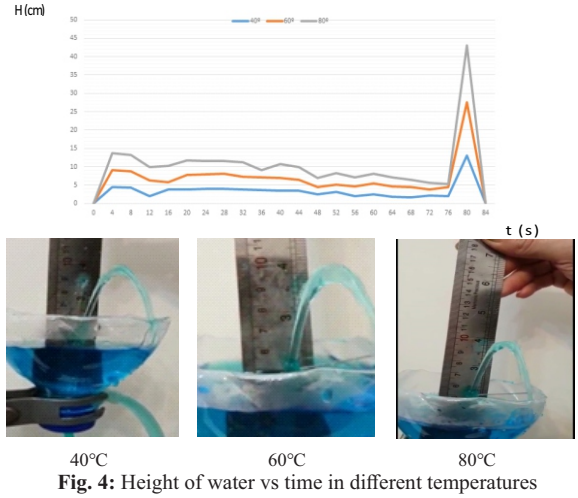

Fig. 4: Height of water vs time in different temperatures

The starting peak is observed in these temperatures then the last peak which is upper than the first one is produced.
At the highest temperature (80°C) we see the highest peaks at first and last moments and higher duration; but, for two other temperatures are not the same; as the results show, as we lower the temp we'll get the lower range for height of fountain and exactly is the same for 40°C.

4-2 Different heights in air & water supplies

In upper height, high pressure probably can have higher fountain too.

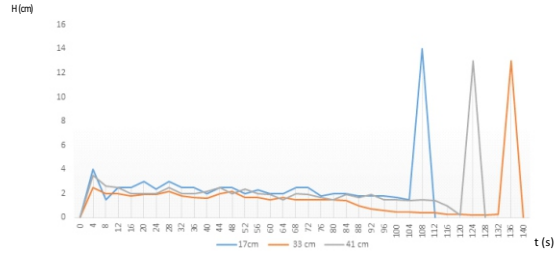

Fig. 5: Height of fountain vs time in different height

As the results from the experiments, higher distance give us higher range of fountain because it makes higher pressure for the water we have in the system. The higher height of fountain, is for higher height (41cm) and the lower one is for the lower height (17cm).

4-3 Different diameters

If we change the diameters of the last pipe that we are going to have the jet from, we'll see that the amount of the water coming out passing time is different in each diameter because the pressure is different in each pipe. Here different 3 diameters have been experimented with different results .

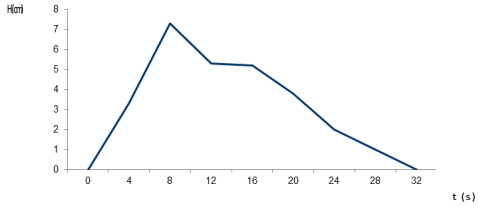

Fig. 6: 7.02 mm Diameter

As shown in Fig. (5), the first peak is in 8cm point, then we have the reduction of the height because of the energy loss and the amount of the water that is becoming low. But there is no the last peak as the other results because the pressure was not enough for pumping the water.

For 4.1mm diameter the first peak is seen but we noticed the point is lower than the last diameter but after the peak we have the duration but we don't have the last peak . The water doesn't have any movement on the pipe because there is no external forces on the system to pump the water out .

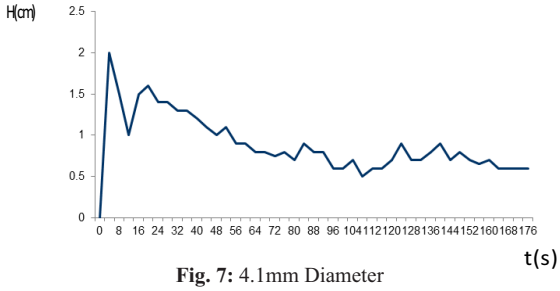

Fig. 7: 4.1mm Diameter

The best result of all diameters was for 3.2 mm that we can see the first and last peaks and the duration between and it shows that energy of the system is used in a correct way and energy loss was lower than the last two results.

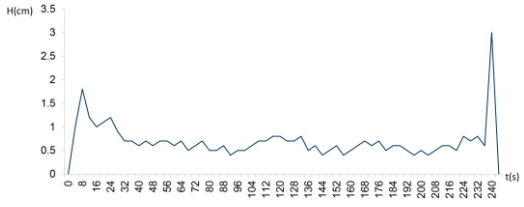

Fig. 8: 3.2mm Diameter

5 Conclusion

1- As was explained in our experiments, in higher temperature of the water in the system, the pressure of the liquid will be higher too so we can have higher fountain.

2- As was mentioned , higher height will store more energy in the liquid and more energy equals to more pressure of water, and the more pressure causes more height for the water jet.

3- The changes in diameter of tubes will absolutely cause some effects on the height because the forces and energies in the system are high; as we lower the diameter of the waters pumping tube, it will need less energy for pumping it, but the high amount of forces let the water pumps higher.

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INVESTIGATING SOME PARAMETERS IN BLOOD PRESSURE

Mahta moradi ,Farzanegan 2 School , Tehran /Iran , mahtamoradi83@gmail.com

ARTICLE INFO

Participated in IYNT 2018, Tbilisi , Georgia (12-16 years old)

Supervisor: Yasamin Masoumi Sefidkhani

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

This is a problem in International Young Naturalists' Tournament, IYNT 2018, to study the accuracy of various methods to measure blood pressure. Propose an interesting study involving blood pressure and pulse. What is blood pressure and also different methods to measure it? To find affecting parameters like music , color and eating on blood pressure and pulse is the main aim in this problem.

1 Introduction

The pulse is the heart rate, or the number of times the heart beats in one minute. Pulse rates vary from person to person. It is lower when you are at rest and increases when you exercise (more oxygen is needed by the body when you exercise). But what do the numbers of the blood pressure mean?

Every blood pressure reading consists of two numbers or levels. They are shown as one number on top of the other. The first (or top) number is your systolic blood pressure. It is the highest level your blood pressure reaches when your heart beats. The second (or bottom) number is your diastolic blood pressure. It is the lowest level your blood pressure reaches as your heart relaxes between beats. Having high blood pressure (hypertension) is not usually something that you feel or notice. The only way is measuring to know if you have blood pressure or not. Blood pressure is measured in 'millimeters of mercury' (mmHg) and is written as two numbers. For example, if your reading is 120/80mmHg, your blood pressure is '120 over 80'.

2 Blood pressure in different ages

Using the blood pressure chart (Fig. 1) to find what your blood pressure readings mean, just find your top number (systolic) on the left side and read across, the bottom number (diastolic) . Where the two meet is your blood pressure.

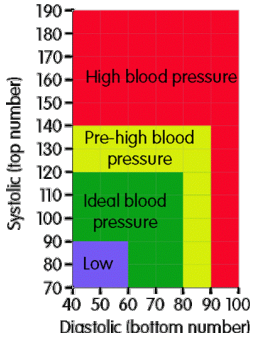

Fig. 1: Blood pressure chart

Normal blood pressure and pulse in several ages are compared in Fig. (2).

	age	Min	Normal	max
Childhood	1 to 12 months	75.50	90.60	100.75
	1 to 5 years	80.55	95.65	110.77
	6 to 13 years	90.60	105.70	115.80
	14 to 19 years	105.73	117.77	120.81
adulthood	20 to 24 years	108.75	120.79	132.83
	25 to 29 years	109.76	121.80	133.84
	30 to 34 years	110.77	122.81	134.85
	35 to 39 years	111.78	123.82	135.86
elderly	40 to 44 years	112.79	125.83	137.87
	45 to 49 years	115.80	127.84	139. 88
	50 to 54 years	116.81	129.85	142.89
	55 to 59 years	118.82	131.86	144.90
	60 to 64 years	121.83	134.07	147.91

Fig. 2: Normal blood pressure and pulse in different ages

The following is a table of normal resting heart rates at different ages (Fig. 3).The resting heart rate will increase in response to a variety of changes, including exercise, body temperature, emotional triggers, and body position, such as for a short while after standing up quickly.

Age	Normal heart rate (bpm)
Up to 1 month	70 to 190
From 1 to 11 months	80 to 160
From 1 to 2 years	80 to 130
From 3 to 4 years	80 to 120
From 5 to 6 years	75 to 115
From 7 to 9 years	70 to 110
20 years	100 to 170
30 years	95 to 162
35 years	93 to 157
40 years	90 to 153
45 years	88 to 149
50 years	85 to 145
55 years	83 to 140
60 years	80 to 136
65 years	78 to 132
70 years	75 to 128

Fig. 3: Normal resting heart rates at different ages

3 Different Methods to measure the blood prssure and heart rate or pulse

Methods for measuring the blood pressure are as :

- Auscultatoric measurement devices
- Quicksilver-sphygmomanometer
- Stethoscope

and for heart rate (Fig. 4):

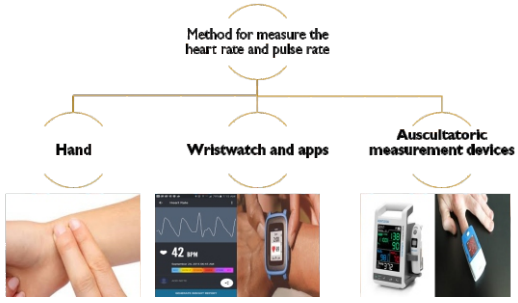

Fig. 4: Heart and pulse rate measuring methods

3-1 Quicksilver-sphygmomanometer

This sort of blood pressure measurement device is called the 'olden standard' of blood pressure measurement because it is highly reliable and accurate. This is why it is predominantly used as a reference system in clinical validation studies and the underlying measurement principle is the same is the one of stethoscopes.

3-2 Stethoscope

The stethoscope is an acoustic medical device for auscultation, or listening to the internal sounds of an animal or human body. It typically has a small disc-shaped resonator that is placed against the chest, and two tubes connected to earpieces which is often used to listen to lung and heat sound . It is also used to listen to intestines and blood flow in arteries and veins. (Fig.5).

Fig. 5: stethoscope

3-3 Auscultation devices

Auscultation devices determine blood pressure by monitoring Korotkoff sounds. Then the pressure in the cuff is slowly released. When blood starts to flow into the artery, the turbulent flow creates a pulse synchronic pounding (first Korotkoff sound). The pressure at which this sound is first detected is the systolic blood pressure. The cuff pressure is further released until no more sound can be detected at the diastolic arterial pressure (Fig.6).

Fig. 6: Auscultation device

4 Accuracy of various methods to measure blood pressure

By comparison , it is found that the accuracy of various methods are:

Auscultation measurement devices ⮜ Stethoscope ⮜ Quicksilver-sphygmomanometer

5 Polygraph

Polygraph is based on measuring the function of the human body . Results of this measuring can show as the people say right or not. Then the pulse, blood pressure , electricity of the body and speed of breathing are measured. We made one polygraph which works on the base of pulse or heart rate (Fig. 7) and asked questions such as: did you passt the red light? or questions they didn't know the answer and we measured their pulse, blood pressure , electricity of their body and speed of breathing. After these measurements we compared the parameters.

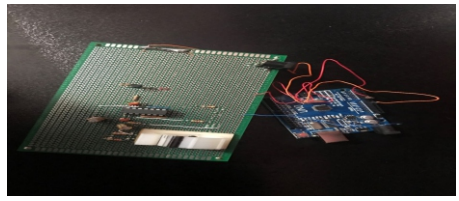

Fig. 7: Polygraph was made in our experiment

6 Experiments

One of the environmental factors which can affect on body of human is color. We used monitors with different colors. Different genders were asked to watch the monitors about 30 minutes. After that their blood pressures and heart rates were measured.

$p_{i=inital\ blood\ pressure}$

$p_{f=final\ blood\ pressure}$

$$\Delta p = p_{f-}p_i$$

$$\frac{\Delta p}{p_i} \times 100$$

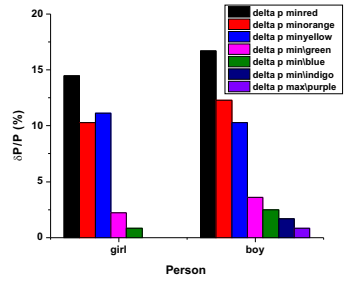

Fig. 8: Investigation of color effect on heart rate in different genders and ages

Different genders were asked to eat salt and sugar. Then their blood pressure and heart rate were measured.

Fig. 9: Investigation of salt and sugar effect in blood Pressure in different genders and ages

The effect of music was investigated too.

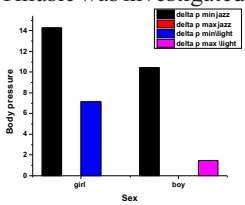

Fig. 10: Investigation of music effect in blood Pressure in different genders and ages

Blood pressure and heart rate in the different time of the day were measured too.

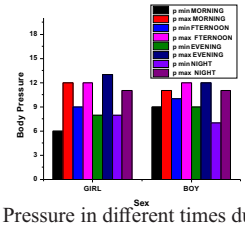

Fig. 11: Blood Pressure in different times during the day (among several genders and ages)

7 Conclusion

To measure the blood pressure we have 3 methods:

- Stethoscope
- Quicksilver-sphygmomanometer
- Auscultatoric measurement devices

To measure the heart rate and pulse rate we have 3 methods:

- APP and wristwatch
- Hand
- Auscultatoric measurement devices

The average results in our graphs show the change of heart rate and blood pressure of boys are more than girls and in different ages when the age is going to be upper, the blood pressure is going upper too but when the age is going to upper, heart rate is going to be less .

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DANCING COIN

Parsa Ghalibaf Khorasani, Arman institute , Mashhad/Iran

ARTICLE INFO

Presented in ICYS 2018, Belgrade, Serbia

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

In this research parameters that are effective on a dancing coin which is on the neck of a strongly cooled bottle have been investigated. The noise of the jumping coin and its jumping depend on the bottle's volume , temperature difference between inside and outside of the bottle, bottle's material and coin's mass that they will change the results of balance time, number of coin's jumping, height of jumping and the amount of exiting gas (air). Concepts such as perfect gas law, molar specific heat, Fourier heat transfer law and Transient thermal conductivity have been studied to justify the coin's behavior.

1 Introduction

The heat transfers from the heat source to the bottle. As the heat increases, based on perfect gas law the pressure of the air inside the bottle increases too. Therefore, the air tries to escape through the mouth of the bottle, and push the coin out. If the air's force is more than atmosphere pressure and coin's mass, the coin starts jumping.

As the bottle is put inside the hot water we will hear a noise and we will see the coin's jumping. After putting the bottle inside the cold water , the temperature of the air inside it decreases and after putting it inside the hot water it goes up. High temperature will make more molecular movement and it rises the pressure.

2 Theory

Hot water makes the bottle warm and increases inner energy which makes some vibrations in coin [1].

$$sin\theta = \theta, \cos\theta = \theta \quad (1)$$

$$x \cong d = 2R\theta \quad (2)$$

$$w = F.x = Fx\,cos\beta = F2R\theta$$

$$Q + \Delta U = W \quad (3)$$

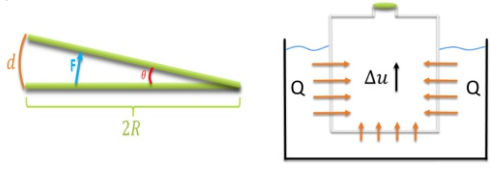

Fig. 1: Thermal conductivity and vibration

$$mc\Delta T + nC_v = W \quad (4)$$

$$\Delta T(mc + nC_v) = 2FR\theta \quad (5)$$

$$\frac{\Delta T(mc + nC_v)}{2R\theta} = F \quad (6)$$

$$Mg\,cos\theta = F \quad (7)$$

$$\frac{\Delta T(mc + nC_v)}{2RMg} = \theta \quad (8)$$

Q = heat
m = water mass
C = thermal capacity
n = Number of molar
C_v =Molar thermal heat in constant volume
ΔU = inner energy
M= coin's mass

3 Experiments

As the general description of the experiment , some effective factors have been studied to find coin's behavior.

Bottle's volume : which takes longer time to get heated if it has more air inside . Then number of jumping will be more because more air molecules inside the bottle want to be excited to go outside and more jumps will happen.

Bottle's wall diameter: it affects on conduction as: when L increases the thermal conductivity will decrease and the interval will increase too.

Bottle's type: We have different types of bottles like metal, glass and plastic which their thermal conductivities are different. Metal has more conductivity than the other two types. Thermal conductivity of these three types are:
Metal = 72.7, 71.8
Glass = 0.8, 0.9, 1.2, 1.4
Plastic = 0.42, 0.52
The time between jumps is less in higher thermal conductivity so time to reach balance will be earlier.

Coin's mass: When coin has more mass , more force is needed then time of the first jump will be longer . Also more air molecules exit in each jump and the number of jumps will decrease too.

Liquid temperature: When the temperature around the bottle is higher , it can make more force and because of that the amount of air molecules exit in each jump and then the number of jumps , will increase .

Reason for the sounds: Existence of surface tension (Bubbles) and collision with edge of the bottle make sound.

4 Conclusion

In this research, thermodynamic processes were studied and different factors, such as:_Bottle's volume, Bottle's wall diameter, Bottle's type, Coin's mass, Liquid temperature (most effective factor), were investigated which have the effective roles in the experiment.

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Antimicrobial Potential of Biosurfactant Isolated From Oil-Degrading Bacteria Against Multi-Drug-Resistant Pathogens

Anita Shafiee Sabet, Farzanegan 1 High School,Tehran/Iran , anita.shafiee.79@gmail.com

ARTICLE INFO

Participated in ICYS 2018, Belgrade, Serbia

Accepted in country selection by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org , info@ayimi.org

ABSTRACT

Hospital acquired infections are still a serious and common issue around the world leading to many undesirable consequences and even death of considerable percent of patients. Among the possible solutions, using biosurfactants seem to result in promising outcomes. The biosurfactant used in present work is derived out of existing bacteria in oil-contaminated soils in different refinery sites in Iran. The results of the antimicrobial activities of biosurfactants against Staphylococcus aureus and Pseudomonas aeruginosa were promising. Therefore, isolated strain of oil-contaminated soil may be a valuable candidate of favorable biosurfactant-producing bacteria for the inhabitation of infectious bacteria.

1 Introduction

Nowadays, hospital acquired infections are the origin of some usual diseases. These diseases could result in extending the healing process or even death depending on the microbe and the defense system of the patient. Usually the weaker people like babies, old people and cancer patients are more affected by these infections in hospitals [1]. Currently, there are some methods in order to overcome these happenings such as recognizing these infections and disinfecting using Ultra Violet (UV) light etc. [2] One type of the hospital acquired infections happens because of the bacterial biofilm. Biofilm is a stable bacterial colony with the possibility of cytoplasmic collaboration on a surface that is surrounded by a matrix which is made of polymer material outside the cell having microbial base. In this study, biosurfactants are used in order to overcome these issues. Surface active agents (biosurfactants) are materials that could diminish the existing surface tensions between surfaces because of their bipolar molecular structure [3]. The biosurfactant compounds are widely used in pharmaceutical industries. Besides, these materials are biodegradable and have less toxicity comparing with synthesized surfactants. In this study, the biosurfactants are derived out from oil contaminated soils as a bacterial source and purified. The oil contaminated soils were collected from various locations of Iran and the influence of produced biosurfactant was investigated.

2 Literature review

There have been done a lot of researches during past years to control the common existing bacterial biofilms in hospital environments such as Staphylococcus Aureus and Pseudomonas Aeruginosa. According to Rienzo *et al.* (2016), the antibacterial effects of biosurfactant on gram-positive bacteria (Staphylococcus Aureus) was more than Pseudomonas Aeruginosa's biofilm [4]. Primo *et al.* (2015), showed that the effects of biosurfactant were very remarkable on movement, signaling and structure of herbal biofilms [5]. Ciandrini *et al.* (2016), figured out that decomposed biosurfactant could reduce the surface tension of oil paraffin [6]. Mostafapour *et al.* (2014), implemented researches in order to identify a bacterial strain of Bacillus Cereus that produces biosurfactant and evaluated its antibacterial characteristics. In this study different samples were considered such as water, oil and oil containing soil. The ability to make emulsion and surface tension properties were considered using biochemistry tests. According to their results Bacillus Cereus 43 showed a good reduction in surface tension and the derived biosurfactant from this sample had desirable antibacterial effects. Thus they have the potential to be used in biotechnology and bioenvironmental applications [7].
Shahaliyan *et al.* (2013), analyzed the sediments to compare the biosurfactant growth and production of living bacteria in some oil contaminated sediments. The results show that the Pseudomonas growth as a biosurfactant producing bacteria was more than Alcaligenes denitrificans. This was because of increasing the solubility of anthracene and making this hydrocarbon available [8].
Safari *et al.* (2011), worked on deriving the microorganisms that could produce biosurfactant and their properties on the surface. One of the ten samples in this study had the possibility of biosurfactant production in big amounts. This bacteria was named Caspian Petroleum A1 (CPA1). This strain (CPA1) was defined as a biosurfactant producing bacteria having the ability of decomposing gas oil, oil, anthracene and naphthalene [9].

3 Experimental Methods

In this study, 6 aerobe bacteria were derived from oil contaminated soils of different parts of Iran and were purified during several steps. The produced biosurfactant were tested in oil spreading tests. Three samples showed desirable results. Then the tests were done in order to understand their effects and properties.

3-1 Sampling

Due to the properties of different biosurfactants in microorganisms it seems possible to reach the microorganisms which could produce these compounds from different regions. In fact, there is a higher chance to isolate microorganisms producing biosurfactant from the soils containing hydrophobic substances. Accordingly, the separation took place on oil contaminated soils of regions like Qom, Shazand Arak refinery, Khark, Gachsaran, Siri

and Khangiran. Then, the soils were grounded using a mortar, and big particles of the samples were removed. In order to protect the existing microbes in the soils, they were remained in room temperature (25°C).

In this study, enrichment is used in order to separate the bacteria which produce biosurfactant from the soils contaminated by hydrophobic compounds.

3-2 Microorganism separation using enrichment method with hydrocarbon substrate

This method is based on creating a proper condition for growth of the desired isolate and making the conditions bad for the other undesirable bacteria. In order to perform the enrichment, the bushnellhas broth containing 1% crude oil as a carbon source was used. The homogenized soil samples, a part of Bushnellhas broth and 1 % crude oil were poured in Erlenmeyer flask and kept in shaker for one week in 25 °C and 180 rpm. Next, 100 µl of each Erlenmeyer flask added to nutrient agar and cultured and the plates incubated at 25 °C for one week, and each day the plates were monitored in order to find new colonies [6].

3-3 Purification of the microbial isolates

After proper heating the nutrient agar plates, the grown microbial isolates were purified individually and the repetitive isolates were identified.

3-4 Biosurfactant production using selected microbes in liquid culture

In this test to produce the biosurfactant, a little part of each culture medium were poured in different plates and kept for 7 days at 29 °C. A plate of new microbial culture added to each plate. Heating implemented for 7 days in shaker incubator at 25 °C and 180 rpm. Then, in order to separate the biomass from the fermentation liquid each plate was centrifuged with 4000 rpm, and the upper liquid was transmitted through filter paper number 1. The remained existing oil on upper liquid layer was separated using decanter. Finally, existence of the biosurfactants in each sample was evaluated using oil and parafilm spreading tests.

3-5 Investigation of produced biosurfactant using oil spreading test

This method is a useful and rapid way to early evaluation of the strain that have the ability to produce biosurfactant. In this process, 40 µl distilled water was poured in a glass plate at first. Then, 50 µl of crude oil was placed on the center of the plate in order to create a layer of oil on the existing water. Next, 30 µl of upper layer of the centrifuged liquid was poured on the center of the oil layer. This way, the movement of oil from the center to outer area was considered as a criterion of biosurfactant production. The resulting halo diameter in this method depends on the biosurfactant viscosity and this method could be considered as a qualitative test to evaluate the produced biosurfactant [10].

3-6 parafilm

In this method 25 µl of upper layer of the produced liquid from centrifuge was settled on hydrophobic parafilm. The resultant droplet should be dispersed if there is biosurfactant. But if there is no surface active compounds the droplet remains with its early geometry and will not be dispersed. This could also be used as a criterion of existence of the biosurfactant.

3-7 Biosurfactant extraction

In order to extract the biosurfactant, the colony of the selected isolate was added to a 1000 ml Erlenmeyer . Then, the mixed liquid was kept in 25 °C of heating and 150 rpm for 7 days. The bacterial cell were removed after 20 min of 4000 rpm centrifuge in 5 °C and the upper layer was stored. The pH of liquid was set to 2:1 M by using sulfuric acid. Afterwards, chloroform and methanol was added having the similar volume fraction (1:2). The organic phase was separated and was vapored in 60 °C in oven. The final product was brown as crude biosurfactant [3].

3-8 Antibacterial evaluation of the biosurfactant

The produced suspension of biosurfactant was used to evaluate the antibacterial effect. Spreading in agar was utilized as a qualitative method. In this method, the standardized microbial suspension was spread on Mueller-Hinton agar. Then, for antibacterial analysis, paper discs, having appropriate distance from each other, were put on the plate and about 20 µl of solvent were poured on the discs. Next, the culture medium containing the bacteria remained for 24 h in 37 °C in the incubator. Eventually, measuring the resulting halo diameters around the discs was performed [6].

4 Materials and Methods

4-1 Sampling

In this step 10 soil samples were gathered from Qom, Shazand Arak refinery, Khark, Maroon, Gachsaran, Siri and a gas contaminated soil sample from Khangiran, and the samples were delivered to the laboratory in shortest time.

4-2 Preparation of liquid culture environment

300 ml Bushnellhas broth was prepared containing mineral substances, oil as carbon source and peptone as nitrogen source for bacteria nutrition. Then poured in six 50 ml Erlenmeyer flask . Then, 0.5 g of the samples was added in each Erlenmeyer and they were remained for one week in shaker in order to prevent the sediment formation and better air feeding to the aerobic bacteria (Fig. 1).

Fig. 1: The liquid culture medium before sterilization, the samples on a shaker, adding soil to culture medium; three different procedures (from left to right)

4-3 Screening of bacteria

In this step, 50 ml of the samples was poured on nutrient agar. The plates were remained in incubator in 37 °C for one week and were observed each 24 h to be informed about the new colonies before their unlimited growth.

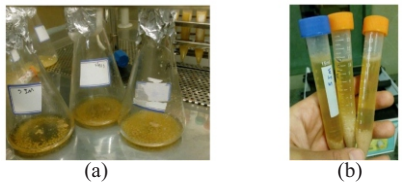
4-4 Purification of the colonies from the culture medium

The colonies were purified by mean of four step culturing using loop in nutrient agar (Fig.2). At first, their shape and color were used for distinguishing. Then, they were compared by Gram staining.

Fig.2: Purified colonies

4-5 Biosurfactant production test

Biosurfactant production tests were needed in order to analyze the productivity of each sample's biosurfactant product. For this purpose, a culture medium was prepared containing peptone, as Nitrogen source, and olive oil in little amount, as carbon source (Fig.3 a/b). The carbon source in this step was less than the previous step because here it was used to help initial growth of bacteria while in the previous step it was utilized to make the growth of strong bacteria as hard as possible.



(a) (b)

Fig.3: a) The produced biosurfactant , b) after centrifuge

4-6 Biosurfactant effectiveness test

After seven days, the samples were centrifuged to create sediment of bacteria on the bottom and be separated from the produced biosurfactant. For effectiveness tests oil spreading and parafilm tests were utilized. For oil spreading test, 40 ml of water was poured in six plates. Then, 50 µl oil and 30 µl biosurfactant sample added to each plate. The resultant halo diameter was measured and considered as an effectiveness criteria of the produced biosurfactant. Figure (4) , and Table 1 demonstrate the results of oil spreading tests for different samples.

As the parafilm test, 10 µl of water was poured on a parafilm layer as the negative control sample and then 10 µl of produced biosurfactant samples put on the parafilm in order to observe the influence of biosurfactant on parafilm.

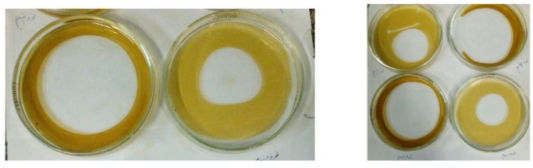


Fig. 4: Comparing the samples by the halo diameter

4-7 Influence of biosurfactant on pathogenic bacteria

Firstly, each of Staphylococcus Aureus and Pseudomonas Aeruginosa were solved in 100 µl of physiologic serum. To be sure about the homogeneity a vortex was used. Spectrophotometer was employed to evaluate the viscosity of the solvent. This amount should be between 1.5 and 2 OD, then each bacteria was cultured on solid nutrient agar. In order to evaluate the influences on bacteria the disc method was utilized.

A few minutes was spent for settling down of bacteria on the environment. For each plate, disc of containing the sample, disc containing antibiotic and one disc containing the solvent as the control sample was used. The solvent was 3 h in refrigerator to spread in the environment and then they were put in the incubator of 37 °C. After one day, result of the zone of inhibition showed 15 mm of diameter (Fig. 5).

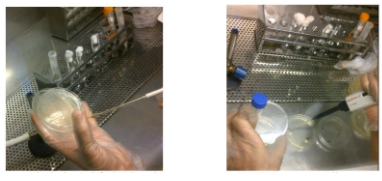


Fig. 5: Subculturing the infectious bacteria and Well test; from left to right

5 Results and discussions

5.1. Oil spreading test

The oil spreading test results is shown in Table (1).

Table 1: Oil spreading test results

Halo diameter (cm)	Sample
10	Ash(1)
5	A1S6
1.5	Si
7	Asha(3)
7.5	Ash(2)
4	Sh(1)
1	Control

5-2 Antibacterial effect of the biosurfactant

The most effective sample was utilized for test on the suspension of separated pathogenic bacteria (Fig. 6). The outcome result showed that the produced biosurfactant out of Ash(1) bacteria had more effects on Pseudomonas Aeruginosa and showed a halo of 1.5 cm.

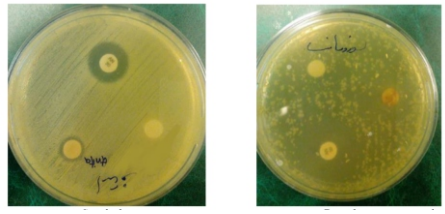


Fig 6: Staphylococcus aureus and Pseudomonas aeruginosa (left to right)

6 Conclusion

According to the results of this project, isolated strain of oil-contaminated soil may be a valuable candidate of favorable biosurfactant-producing bacteria for the inhabitation of infectious and multi-drug-resistant bacterias.

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UPCOMING EVENTS

>> Persian Young Physicists' Tournament, PYPT 2019, Tehran, Iran

>> International Young Physicists' Tournament, IYPT 2019, Warsaw Poland

>> Persian Young Naturalists' Tournament, PYNT 2019, Tehran , Iran

>> International Young Naturalists' Tournament, IYNT 2019, Minsk, Belarus

>> Iran Physicists' Tournament, IRPT2019, Tehran, Iran

>> International Physicists' Tournament, IPT2019, Lausanne , Swiss

>> Iran Chemistry Tournament, IRChTo 2019, Tehran, Iran

>> International Chemistry Tournament, IChTo 2019, Moscow, Russia

>> Iran Conference of Young Scientists, IRCYS 2019, Tehran, Iran

>> International Conference of Young Scientists, ICYS 2019, Kuala Lumpur, Malaysia

>> International Young Scientists' Innovation Exhibition , IYSIE 2019, Kuala Lumpur, Malaysia

>> International Conference of Young Social Scientists, ICYSS 2019. Slovenia,

>> Iran Junior Science Olympiad, IRJSO 2019, Tehran, Iran

>> International Junior Science Olympiad, IJSO 2019,Qatar

Ariaian Young Innovative Minds Institute, AYIMI
Unit 14, No. 32, Malek Ave., Shariati St.
Post Code: 1565843537
Tel - Fax: +9821-77522395, 77507013
Tehran/ Iran
URL: http://www.ayimi.org
http://journal.ayimi.org
Email: info@ayimi.org