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Three Stages of Indirect Evaporative Cooling: Experimental and Theoretical Evaluation Study*

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ABSTRACT

Economical energy, reduction of cost and utilization of clean energy are required to meet the human needs. Evaporative cooling units are considered as a solution for these require -cements by transforming such systems into technologies that meet these needs. The equipment's cost, installation and oper-acting costs are simple and low compared with refrigeration systems. An effective design is obtained by employing three stages settlement that equipped with a cross flow heat exchan-ger,direct and indirect evaporative coolers. In order to assess the design performance, a program code is developed. Flow and design parameters namely, air flow rate, piping length and diameter are studied. In addition to that the inlet air-dry bulb temperature at several different time duration over day is studied. The study was conducted in Tikrit University, Iraq (34.35N;43.37E).Readings are recorded in June, July and end of August for two days(24hours a day). The results show that, saturation of direct evaporative cooler effectiveness varies in the range,67%-96% and overall effectiveness of the unit varies in the range,80%-120%.It is provided that the system is efficient in dry and hot areas, and an improvement in the performance of the current design is achieved successfully.

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Effect of Climate and Design parameters on the Temperature Distribution of a Room

Fayadh Mohammed Abed[a], Omer Khalil Ahmed[b], Ahmed Emad Ahmed[c]

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Highlights

- The purpose of this paper is to determine the size of the window on the temperature distribution and air velocity of rooms.
- The experimental investigation contained manufacturing four test rooms where the window areas were 25%, 50%, 75%, and 100% from facade area.
- A numerical analysis was carried out using the Fluent software. The Fluent results agreed well with the experimental data obtained.
- The room with 25% of the facade had the best performance in comparison with other designs.

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Modeling of an industrial naphtha isomerization reactor and development and assessment of a new isomerization process

Ahmed M. Ahmed [a], Aysar T. Jarullah [a], Fayadh M. Abed [b], Iqbal M. Mujtaba [c]

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Highlights

- Mathematical model of an industrial naphtha izomerization reactor is developed.
- Parameter estimation technique is utilized to find the best kinetic parameters.
- The optimal design of the reactor is validated against industrial experimental data.
- A new izomerization process is proposed and its performance is evaluated.

Abstract

Naphtha isomerization is an important issue in petroleum industries and it has to be a simple and cost effective technology for producing clean fuel with high gasoline octane number. In this work, based on real industrial data, a detailed process model is developed for an existing naphtha isomerization reactor of Baiji North Refinery (BNR) of Iraq which involves estimation of the kinetic parameters of the reactor. The optimal values of the kinetic parameters are estimated via minimizing the sum of squared errors between the predicted and the experimental data of BNR. Finally, a new isomerization process (named as AJAM process) is proposed and using the reactor model developed earlier, the reactor condition is optimized which maximizes the yield and research octane number (RON) of the reactor.

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Assessment of heat transfer and fluid flow characteristics within finned flat tube

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ABSTRACT

In this paper, the heat transfer and flow characteristic of air over flat finned tube with perforated and non-perforated fin have been carried out numerically. The mesh generation and finite volume analyses have been conducted using Ansys 15 with a RNG k–e turbulent model to estimate heat transfer coefficient and pressure drop. The free stream velocity ranging between 3,4,5,6, and 7 m/s have been applied for all cases in the simulation and verified with the available data. A satisfactory agreement was found between the percent results and the references with a maximum deviation of 7% for the finned circular tube with solid fin. The results present a considerable enhancement in Nusselt number with using perforation technique, where the perforation provide 8.5%, 13.6% and 18.4% enhancement using circular, square and triangular perforation respectively. Triangular perforation model offers a considerable finding due to the increment in the Nusselt number comparing to the pressure drop.

1. Introduction

The heat exchangers with finned tube have been widely used in industries and automotive application. The thermal resistance is the most effective factor in the heat exchanger performance. Furthermore, the extended surface geometry plays a vital role in the heat exchanger design. However, the passive methods such as rough and extended surfaces with different geometries like slotted fins, fins with wavy shape and perforated fins considered an effective technique for thermal performance enhancement [1–9].

According to Webb [10], circular heat exchanger and plate fin heat exchanger have been studied and the results suggested to use punched and slotted fins for heat transfer enhancement. Moreover, for the validation process, Webb [10] advised utilizing the correlation of Briggs and Young [11], for heat transfer and the correlation of Robinson and Briggs [12] for pressure drop. Zhukauskas [12], studied a flow in tube bundles with three regimes of laminar flow, turbulent flow, and separated flow and stated that in order to improve the heat exchanger thermal performance, an artificial technique to decrease the boundary layer. Furthermore, another correlation has been proposed by Zhukauskas [12] for the Nusselt number and friction factor for staggered and inline arranged of finned tube.

According to the study of Sahin et al. [13] of heat transfer enhancement using pin fin and the study of Shaeri et al. [14] of rectangular fins, they stated that the perforation technique increases the fluid surface contact area and this lead to enhance the thermal performance. It's noteworthy that the first numerical investigation of the annular finned tube has been established by Jang et al.[15]. Mon et al. [16] reported a numerical simulation of the annular finned tube with a staggered arrangement under wet and dry operating. The stated that the heat transfer coefficient of the isothermal fin overestimates by 5–35%. Additionally, they proposed

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Determination of the effect of oxidation on attenuation coefficient of (X-ray) by Cu, Zn and their alloys

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Abstract

In this paper we study the effect of the oxidation on the values of total attenuation coefficient for the samples (Cu ,Zn and their alloys Brass (70%Cu +30%Zn), (60%Cu+40%Zn)) . The samples thicknesses chosen (0.02-0.1) cm, the Mo-X-ray tube used with the voltages (20-25-30-35) KV, the effect of oxidation on (μ_L , μ_m) were studied by using the graphic relations, where the effect of oxidation at temperature (100 °C) and oxidation time (1.5,6) hours on the linear and mass attenuation coefficients are studied .It is concluded that best results were achieved for (μ_L , μ_m) at (100 °C) after six hours where (μ_L) increased by the ratio (7.14%,5.76%,8.62%3.77%) respectively, while (μ_m) increased by (7.05%, 5.79%,10.05%,3.55%) respectively by comparing with oxidized samples for time (1.5) hours at voltage 20 KV, it is found a linear relation between the linear and mass attenuation coefficient with the oxidation time. While they are inversely related with increasing X-ray voltages. the effect of oxidation on the structural from of the studied materials was also examined using both the scanning electron microscope and the X-ray diffraction examination.

1. Introduction

Since the discovery of (X-ray) by Rotengen [1] many experiments especially that are related to its attenuation were conducted Thomson ,Held several experiments on the attenuation of (X-ray) by different Materials [2] .

The attenuation of (X-ray) occurs through its interaction with matter . Composite material may offer additional benefits in chemical resistance , physical durability ,and portability, the interaction of (X-ray) with matter is via three main processes photoelectric effect, Compton scattering and pair production. Pair production occurs only for very high energy (X-ray > 1022kev) , the sum of (photoelectric effect ,Compton scattering and pair production) per unit path length were the (X-ray) photon is removed from the beam is called linear attenuation coefficient (μ_L)

$\mu_L = \sigma(\text{photoelectric}) + \sigma\,(\text{Compton}) + \sigma\,(\text{pair})$ (1)

σ = Area of the interaction .

μ_L can be described by the well known equation [6]:

$$\mu_L = \frac{\log^{I_\circ}/_I}{X} \qquad (2)$$

I = Transmitted intensity , I∘ = incident intensity and X = thickness of absorbent ,to find the μ_L for any alloy me may use the equation :

$\mu_L(Alloy) = p_1\,\mu_L(s_1) + p_2\,\mu_L(s_2)$ (3)

Where :P_1 represents the percentage of the first pure sample (s_1)

$P_2 = 1-P_1$ represents the percentage of the second pure sample (s_2)

The fact that linear attenuation coefficient varies with the density of the absorbent limits its use, even if the absorber material is the same. therefore ,the mass attenuation coefficient (μ_m) is much more widely used and is defined as:

$$\mu_m = \frac{\mu_L}{\rho} \quad (cm^2 . gm^{-1}) \qquad (4)$$

Where (ρ) refer to the density of the absorbing medium.

We can introduce a half–thickness, $x_{1/2}$,as :

$$x_{1/2} = \frac{0.693}{\mu_L} \qquad (5)$$

Also the average distance or the mean free path for absorbing medium for a beam of (x-ray) is defined as[3,4,5,6,7]:

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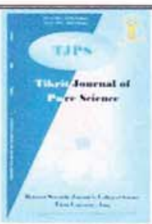

The Physical and Mechanical Properties of a Shape Memory Alloy Reinforced with Carbon Nanotubes (CNTs)

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Abstract

The shape Memory Alloy (SMA) (Copper-Aluminum-Nickel) was prepared in the research by Powder metallurgy (PM) in component percentage (Cu-13% Al-4% Ni), pressure of (500 Mpa) in one direction, and sintering in (800°C) with Nitrogen gas for three hours. (CNTs) was added in percentage (0,0.5,1.0,1.5,2.0,2.5) % as a volumetric ratio at the relatively of the copper ratio to obtain advanced composites for Carbon Nanotubes with a distinct effect on properties.

The elements of the alloy were analyzed using the (EDS) system attached to the Scanning Electron Microscopy (SEM) and study the X-ray Diffraction (XRD) to definition the elements and compounds formed after the process of sintering while imaging the microscopic structure by both Optical Microscopes and (SEM).

The physical characteristics were studied as the results showed that by increasing the content of the Carbon Nanotubes (CNTs), The Bulk Density values of the (Cu-13% Al-4% Ni) decrease by ratio (23.5%) for content of Carbon Nanotubes (0%) to (2.0%) associated with an increase in True Porosity with the increase of the (CNTs) content at the same ratio (27.85%) and the impact is reversed when the content is increased to (2.5%) as it corresponds to the Water Absorption. The decrease in thermal conductivity corresponds to the increase in the True porosity ratio while slightly improving the amount Thermal Conductivity at an add (2.5%) percentage (2.0%) of the (CNTs). Some Mechanical properties, such as Hardness and Compressive Strength, have been reduced by increasing the content of the (CNTs) to (2%) While there has been a slight improvement in these two characteristics at the corresponding ratio.

1-Introduction

The alloy memory of the shape is part of the smart material that has the ability to re-order its dimensions when the thermal stress or mechanical strain external is removed and to be the beginning of the temperature transformation phase. The term alloy memory of the shape (SMAs) is called on the metal materials that has the ability to re Its shape and its initial size were prior to proceeding thermal and mechanical processes, and that property is not limited to metals only but appeared in polymers and ceramics [1,2].

Those Alloys (SMAs) of a unique category of metallic alloys that can be recovered when heated to certain temperatures and the (SMAs) pass to the two phases first a stable phase at the high temperature are called Austanite for the English scientist (William Chandler Austen). The second stage is at low temperatures and is called martinsite for the German scientist (Adolf Martens) [3-5].

Those Alloys(SMAs) are classified into two types controlled by the base material, namely, The Nickel-Titanium alloys and copper-based alloys of their multiplications, their distinctive characteristics and their lesser cost. A copper-based alloys (SMAS) have been developed for high-temperature engineering applications such as remote sensors, engines and because of its ability to work at temperatures close to (200°C) instead of the Ni-Ti alloys that operate at maximum temperature is (100°C). These alloys are