ISSN (O): 2393-8609

International Journal of Aerospace and Mechanical Engineering

Volume 3 – No.3, June 2016

Conservation of energy by improving the design of cooking utensil

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ABSTRACT

This paper explains about how we conserve energy by modified the design of cooking utensils. Energy conservation simply means to reduce the quantity of energy that is used for different purposes. Nowadays, an enormous amount of energy is wasted in different forms so it is necessary to save energy. Energy can save by modifying the design of cooking utensil .Large amount of people are cooking using Liquefied Petroleum Gas (LPG). Liquefied petroleum gas also referred to as simply propane or butane, are flammable mixtures of hydrocarbon gases used as fuel in heating appliances, cooking equipment. Using Liquefied Petroleum Gas leads to large amount of calamities such as carbon emissions mainly carbon monoxide, Nitrogen Dioxide, Sulphur Dioxide. Hence, here is a simple way of conserving energy by reducing the usage of Liquefied Petroleum Gas, a cooking utensil was designed to save energy during the process of cooking.

Keywords

Cooking utensil, Heat Transfer, Cook Ware

1. INTRODUCTION

Cooking pot are generally made up of a material which have high thermal conductivity. Since Aluminium have high thermal conductivity as compared to the other material. Greater is the thermal conductivity greater is the heat transfer rate so we take that material which have high thermal conductivity , but the cost of material is also play an important role . Silver have greater highest thermal conductivity but the cost of silver is also very high. So we take that material which have high thermal conductivity and the cost of that material must be not too high. The bottom of the cooking utensil is coated with non stick coating such as PTFE etc. The cooking utensil was designed in such a way that it can save some amount of energy.

2. METHODOLOGY

CATIA software is very popular for making the design of a prototype. CATIA software makes a prototype at less time. So here we use CATIA software to make cooking utensil.

2.1 CATIA V5

CATIA V5 (Computer aided three- dimensional interactive application) is a pre dominant solver which makes a conceptual design or a prototype at less time consuming rate. It is mainly used in automobile, aerospace, shipping and other industries. There are many workbenches are available to construct a geometry in CATIA v5 such as product, part, sheet metal, surface etc. It saves a time relevance and low cost during conceptual and simulation.

2.2 DESIGN AND DETAILS

This is a sketch of standard cooking utensil having 400mm base diameter 25mm edge fillet, and 200mm height. The base thickness of the cooking utensil is 6.35mm and side wall thickness is 12mm.

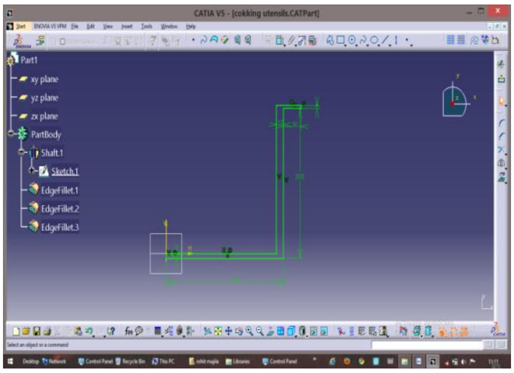

Fig1: STANDARD COOKING UTENSIL DRAWING AND DIMENSION

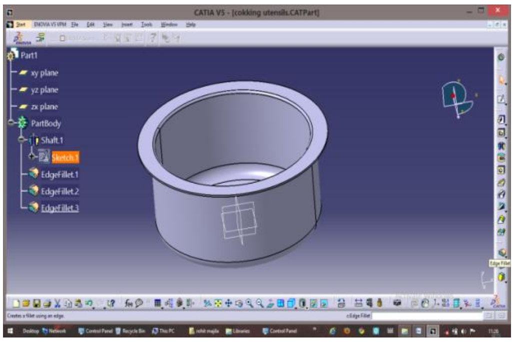

Fig 2: STANDARD COOKING UTENSIL

The experimental cooking utensil is designed in such a way to save energy comparing to other standard utensils. Evaporation is a major source of heat loss during cooking. The experimental cooking utensils were designed such that it has a small projection in the centre which would increase the area of contact thereby increasing the larger area of heat transfer when compared to standard utensils. The projection at the centre is of 40mm diameter at the centre and project the area 12mm upward. The base diameter of the standard cooking utensil is 400mm. From the centre 80mm far apart the area is project 12mm upward.

ISSN (O): 2393-8609
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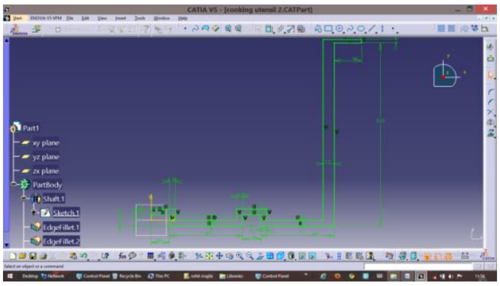

Fig3: EXPERIMENTAL COOKING UTENSIL DRAWING AND DIMENSION

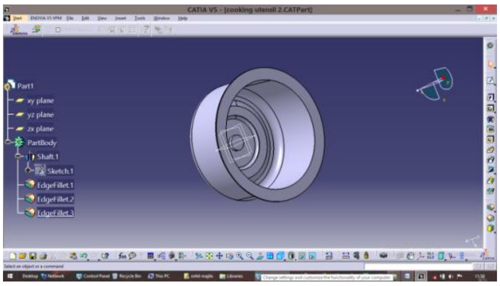

Fig:4: EXPERIMENTAL COOKING UTENSIL

3. CALCULATION

Heat is transferred from a body to another body by virtue of temperature difference. 'Heat transfer' generally takes place due to three modes

1. Conduction
2. Convection.
3. Radiation.

Here we consider only conduction because radiation does not create much more effect as compared to conduction.

According to fourier law :

$Q=K\ A\ (T_1 - T_2)/\ L$

Where Q = Heat transfer rate.

A = Cross-sectional area.

K = Thermal conductivity of the material.

T_1, T_2=Temperature at inner and outer face

L=Length.

3.1 ASSUMPTIONS

1. Steady state conduction which implies that the time rate of heat flow between any two selected points is constant with time.
2. One – directional heat flow.
3. No internal heat generation.
4. Thermal conductivity is constant throughout the surface.

Let us assume utensil is made up of aluminium.

K(Thermal conductivity for aluminium)=202 w/m C.

Let assume that temperature difference is constant say 1 C for both standard and experimental pot.

3.2 FOR STANDARD POT

$Q=K\ A\ (T_1\text{-}T_2)/L$

L=6.65mm or 0.00635m

d=400mm or 0.4m

$A=\pi\ d^2/4$

$A=\pi\times\ (0.4)^2\times/4$

$\mathbf{A=0.1256\ m^2}$

$Q=202\times\ 0.1256\times1/0.00635$

$\mathbf{Q_1=3.9954\times10^3\ W}$

3.3 FOR EXPERIMENTAL POT

Since in experimental pot we project the area upward due to this there is change in surface area

$Q=K\times A\times\ (T_1\text{-}T_2)/L$

$A_1=\pi\times\ (0.4)^2\ \times\ /\ 4$

$\mathbf{A_1=0.1256\ m^2}$

$A_2=2\times\pi\times r\times L$

$A_2=2\times\pi\times0.02\times0.012$

$\mathbf{A_2=1.5072\ \times\ 10^{-3}\ m^2}$

$A_3=2\times\pi\times\ (r_1\text{-}r_2)\ \times L$

$A_3=2\times\pi\times\ (0.0120 - 0.100)\ \times0.012$

$\mathbf{A_3=1.5072\times10^{-3}m^2}$

$A=A_1+A_2+A_3$

$\mathbf{A=0.12861m^2}$

$Q=202\times0.12861\times1/0.00635$

$\mathbf{Q_2=4.09121\times10^3\ W}$

Change in heat $\Delta Q=4.09121\times10^3 - 3.9954\times 10^3$

$\mathbf{\Delta Q=95.81W}$

So, 95.81W amount of extra energy is transferred to the experimental cooking utensil.

Since from above calculations we can say that greater heat is transferred to the experimental cooking utensil as compared to the standard cooking utensil so, the experimental cooking utensil make the food earlier as compared to the standard cooking utensil. This can save both energy and fuel.

4. CONCLUSIONS

It can be concluded that the experimental cooking utensil cook the food few minutes earlier as compared to standard cooking utensil. By Using this cooking utensil we can save some amount of energy as compared to the other pot which are available in market today. However the manufacturing process of this cooking utensil is somewhat difficult but by using this utensil in every house we can reduce global warming.

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