Fabrication and Analysis of Rectangular Finned (ALHE30) Cooking Vessel

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***Abstract*- In day to day life we come across many process, in present concept we were used ALHE30 material as fin for cooking utensils. Fuel consumption is the very important role in India. The present work relates to improve the heat transfer effectiveness of cooking utensils which are commonly used as kitchen gas ranges by the applications of fins and its performance with unfinned vessel. Preliminary work performed on the finned vessel showed that 25% to 35% and cooking time is saved correspondence 15% to 25% saving in the fuel consumption.**

To dissipate heat at faster rate, different heat transfer enhancement methods have been suggested in literature so, the concept of finned cooking vessel is a new initiative even though fins are widely used in industrial applications line heat exchangers, boilers, radiators, refrigeration's and air conditions. In our project work, an effort is made to apply the engineering concept to the day-to-day application by using fins or extended surfaces in the cooking vessel. Cooking vessel is a very important heating process which required large amount of fuel. Hence for, this work lies in saving fuel by reducing heat loss during cooking process.

***Keywords*—Fabrication, Boiling, ALHE30, Temperature.**

I. INTRODUCTION

Cooking is an important daily household activity; it consumes significant amount of energy and human effort. As per 2011 Census, almost 85% of rural households were dependent on traditional biomass for their cooking energy requirements. In urban areas, about 64.5% households are using LPG for cooking purposes. Hence energy conservation or reducing energy wastage during cooking process can contribute greatly towards saving fuels or reducing fuel consumptions.

Different approaches are used for achieving energy efficient operation during cooking includes, switching from conventional biomass to advanced fuel like LPG or Solar energy, which is an urgent need in rural India.

Improving design of cooking stoves which reduces energy wastages or improves combustion efficiency like ASTRA developed by IISc (Indian institute of science) for biomass fuel. Use of technologies to improve heat transfer effectiveness.

Cooking involves heat transfer from burning fuel to the bottom of vessel. It is observed that, during the heating process the heat supplied by flame is not completely utilized for boiling, some of the heat is dissipated .There are various methods to reduce this problem. In study of heat transfer a fin is surface that extends from an object to increase the rate of heat transfer to or from the environment by increasing convection.

Amount of conduction, convection and radiation determines the amount of heat it transfers. There are wide varieties of fin designs available in market fins are incorporated under the vessel and its surrounding made of aluminum .The performance of vessel is determined by varying parameters such as fin thickness, length and spacing .The optimized design is fabricated and the results are compared with plain aluminum vessel and hence fin effectiveness is determined.

Boiling

Boiling is a conversion process involving a change in phase from liquid to vapour .It may occur when a liquid is contact with a surface maintained at a temperature higher than the saturation temperature of the liquid.

Types of Boiling

1. Pool Boiling
2. Flow Boiling

1. Boiling

Pool Boiling is defined as if heat is added to a liquid from a submerged solid surface the boiling process is referred as pool boiling.

Example: Boiling of water in a kettle on a stove

2. Flow Boiling

It occurs in a flowing steam and boiling surface may itself be a portion of the flow passage. This phenomena is generally associated with two phase flows through confined passages.

If the temperature of the liquid is below the saturation temperature, the process is called sub cooled or local boiling. In local boiling, the bubbles formed at the surface eventually contents in the liquid.

If the liquid is maintained at saturation temperature (or higher), the process is called saturated or bulk boiling.

II. LITERATURE

Harshith Vivian D’Costa, Colin Michael Lobo, Clinton Brian Lobo, Frannie Medwin Pinto [4] were investigated “FABRICATION AND ANALYSIS OF FINNED COOKING VESSEL TO IMPROVE” heat transfer effectiveness” .Cooking is an important process used for preparation of food by heating it in the vessel or utensils studies in different parts of India have shown that cooking is the dominant energy using activity in the village energy matrix. It is found that energy consumption for cocking in domestic sector accounts for 40% of total energy usage. Thus ,energy conversion are reducing energy wastage during cooking is very important for us. Experimentally to compare its performance with unfinned vessel to finned vessel. Preliminary work performed on the finned vessel shows that , 20% to 30% cooking time is saved corresponding to 10% to 20% savings in fuel consumption.

J. Mikielwicz, D. M Ikelevicz [2] were investigated “BOILING (EVAPORATION) AND CONDENSATION”: In manufacturing process several heat transfer phenomena will occur, of which boiling or condensation play a very significant role. These processes are usually applied in heat removal from different surfaces and can be found in chemical engineering as well as other area of contemporary technology and have used practical significance just to mention preservative applications in removal of large heat fluxes in electronics and power technologies conversion one phase into the other may proceed equally on the wall and inside the phase; However usually the first of this cases is found in technical applications. Evaporation is the process of turning a liquid, at its saturation temperature into vapor by applying heat. Boiling on solid surface takes place when the temperature of the heated surface is higher than the saturation temperature of the liquid. The process reverse to boiling is condensation ,were vapour turns into liquid due to the removal of heat the necessary condition for the process to occur is that the temperature of surface should be lower than the corresponding saturation temperature of the liquid.

III. ANALYSIS OF UN-FINNED VESSEL & FINNED VESSEL

In performance investigation of both Un-finned and finned vessel, we are using commonly used Aluminium vessels for experimental conduction purpose. The material used for rectangular fin strips is Aluminium HE30 (AlHE30) for finned vessel

The weight of unfinned vessel or normal purchased vessel is 323 grams and the weight of finned vessel (Rectangular finned vessel) is about 416.5 grams.

On bottom surface of the un-finned vessel, 11 rectangular shaped strips are attached by Gas welding process to get a Finned vessel. The rectangular shaped strips are vary in size of central strip of length 15.5cm of 1 nose , $2nd$ strip of length 15cm of 2 nose, $3nd$ $2nd$ strip of length 14cm of 2 nose, $4nd$ strip of length 12.5cm of 2 nose, , $5nd$ strip of length 9.5cm of 2 nose. Totally Finned vessel contains 11 Rectangular shaped strips on bottom of an vessel. Spacing between one strip to another is given as 1.5cm.

Fig.1 unfinned vessel

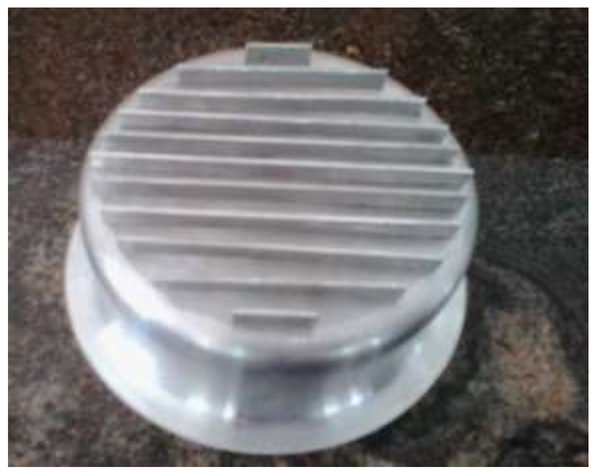


Fig.2 finned vessel

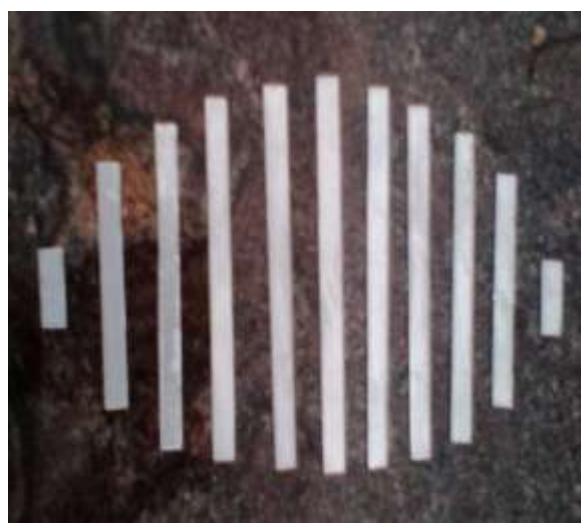


Fig.3 Rectangular fins

IV. EXPERIMENTAL SET UP

Unfinned Vessel

1. Take 750ml of water in a unfinned vessel.
2. Water is heated using LPG stove arrangement with different flow rate of LPG adjusted to 0.166 LPM.
3. Take temperature rise in water for every 30 second is noted using a thermometer and a stop watch.
4. The temperature is noted till water reaches to respective saturation temperature
5. Similarly the testing is done for 1000ml of water and LPM set to 0.25 and 0.33LPM of gas flow rate
6. The results are obtained and are compared.

Fig.4 Boiling without fin vessel

Rectangular Finned Vessel

1. Take 750ml of water in a un finned vessel.
2. Water is heated using LPG stove arrangement with different flow rate of LPG adjusted to 0.166 LPM.
3. Take temperature rise in water for every 30 second is noted using a thermometer and a stop watch.
4. The temperature is noted till water reaches to respective saturation temperature
5. Similarly the testing is done for 1000ml of water and LPM set to 0.25 and 0.33LPM of gas flow rate
6. The results are obtained and are compared.

Fig.5 Experiment by boys calorimeter

V. RESULTS AND DISCUSSION

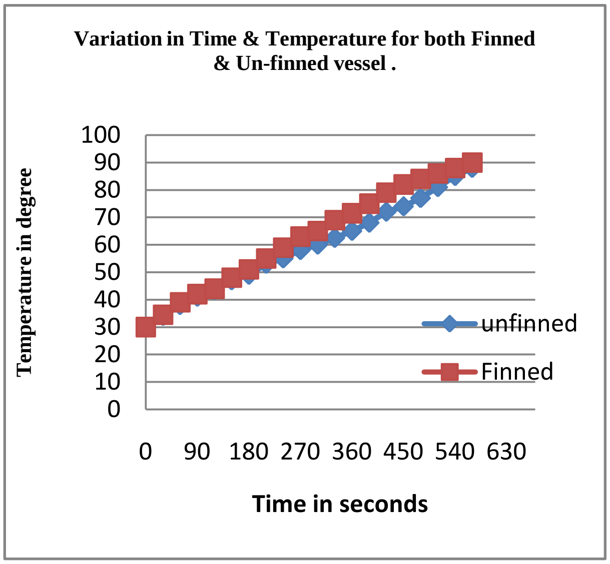
Discussion on the Result obtained by Performance Analysis of un-finned and finned vessel

Boiling of water in un-finned and finned cooking vessel are conducted for different quantities of water of 750ml and 1000ml while considering different gas flow rate of 0.16LPM, and 0.25LPM are tabulated[Table 1 to Table 4]. Compare to unfinned vessel, finned vessel reach the saturation temperature of water nearly 30secounds to 40secounds faster than un-finned vessel.

Table 1 For 1000ml of water & 0.16LPM of gas flow 1000ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/m^2; Gas temperature=33.3°C

Unfinned		Finned	
Time (sec)	Temperature(℃)	Time (sec)	Temperature(℃)
0	30	0	30
30	33.5	30	33
60	36	60	37
90	38	90	38
120	43	120	42
150	45	150	45
180	47	180	47.5
210	49	210	51
240	51	240	54
270	54	270	57
300	56	300	60
330	59	330	63
360	62	360	66
390	65	390	68
420	68	420	71
450	71	450	74

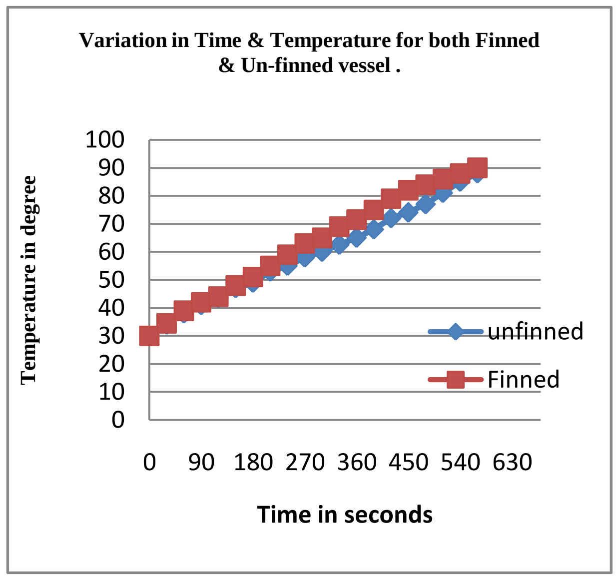
480	73	480	76
510	76	510	79 (Bubbles)
540	79	540	81
570	81 (Bubbles)	570	84
600	82	600	85
630	85	630	87
660	87	660	88.5
690	89	690	90
720	92	720	91
750	93	750	92.5



Graph. 1 For 1000ml of water & 0.16LPM of gas flow 1000ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Table 2 For 750ml of water & 0.16LPM of gas flow 750ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Unfinned		Finned	
Time (sec)	Temperature(℃)	Time (sec)	Temperature(℃)
0	30	0	30
30	34	30	34.5
60	38	60	39
90	41	90	42
120	43.5	120	44
150	47	150	48
180	49	180	51
210	53	210	55
240	55	240	59
270	58	270	63
300	60	300	65
330	62.5	330	69
360	65	360	71.5
390	68	390	75
420	72	420	79
450	74	450	82(Bubbles)
480	77	480	84
510	81	510	86
540	85	540	88
570	88 (Bubbles)	570	90
600	90.5	600	93
630	91.5	630	94
660	92.5	660	95
690	94	690	96
720	95	720	96
750	96	750	98
780	96	780	99

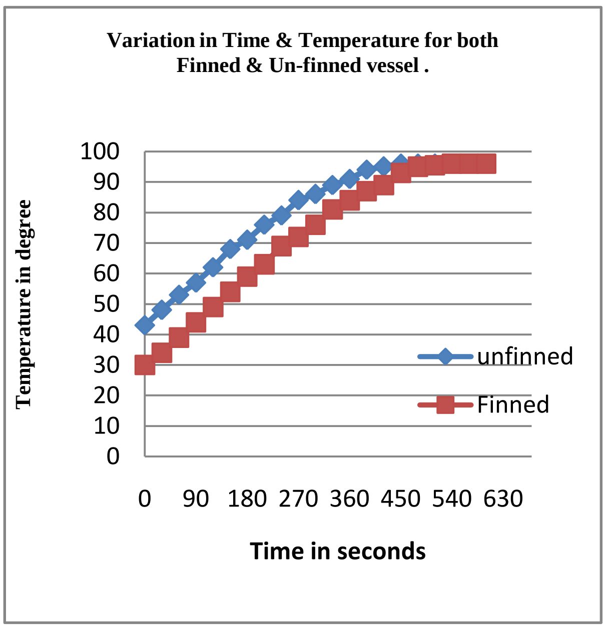


Graph. 2 For 750ml of water & 0.16LPM of gas flow 750ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Table 3 For 750ml of water & 0.25LPM of gas flow 750ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Unfinned		Finned	
Time (sec)	Temperature(℃)	Time (sec)	Temperature(℃)
0	30	0	30
30	34	30	34
60	37	60	39
90	43	90	44
120	48	120	49

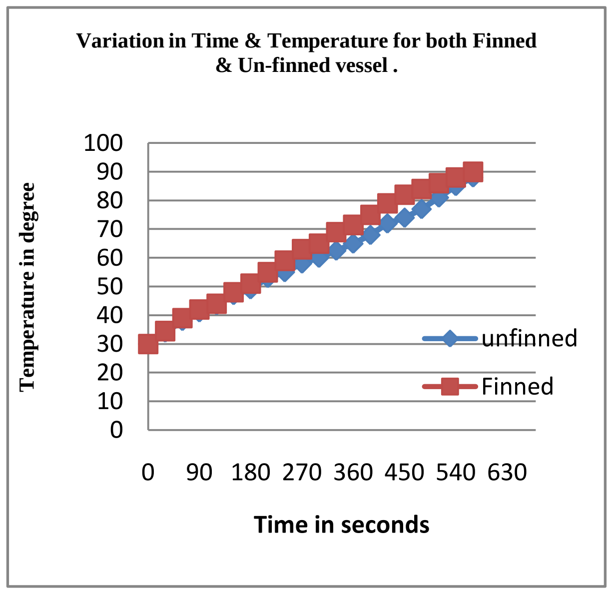
150	53	150	54
180	57	180	59
210	62	210	63
240	68	240	69
270	71	270	72
300	76	300	76
330	79	330	81(Bubbles)
360	84(Bubbles)	360	84
390	86	390	87
420	89	420	89
450	91	450	93
480	94	480	95
510	95	510	95.5
540	96	540	96
570	96	570	96
600	96	600	96



Graph. 3 For 750ml of water & 0.16LPM of gas flow 750ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Table 4 For 1000ml of water & 0.25LPM of gas flow 1000ml of water; 10Lph=0.25Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Unfinned		Finned	
Time (sec)	Temperature(℃)	Time (sec)	Temperature(℃)
0	30	0	30
30	34	30	34
60	37	60	36
90	41	90	40
120	43	120	44
150	48	150	48.5
180	51	180	52
210	54	210	55
240	58	240	59
270	61	270	63
300	64	300	66
330	67	330	68
360	70	360	71
390	74	390	74
420	77	420	78
450	82	450	83
480	84	480	84(Bubble)
510	86(Bubble)	510	87
540	88	540	89
570	93	570	92
600	96	600	96



Graph. 4 For 750ml of water & 0.16LPM of gas flow 750ml of water; 10Lph=0.16Lpm of gas flow Pressure of gas=0.7 kg/$m2$; Gas temperature=33.3℃

Graph 1, Graph 2, Graph 3, Graph 4, are gives that variation in time and temperature for both un-finned and finned vessel for respective quantities of water and gas flow rate are shown in above mentioned graphs. It evident that in finned cooking vessel nearly 25% to 35% cooking time is saved correspondence 15% to 25% saving in the fuel consumption.

VI. CONCLUSION

By the good performance Analysis and heat transfer characteristics of AlHE30 is used as a fin for cooking utensils.

Even though the time takes by finned vessel to reach steady state is more, the heat flux available will be more compared to unfinned vessel. So it can be employed in cooking purpose as there will be more cooking in steady state rather than in transient state. It is useful in place where large amount of food has to be cooked.

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