Journal of Physics Special Topics
An undergraduate physics journal

A3_5 Golden Frying Pan: Is it Worth it?

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November 25, 2021

Abstract

In this paper it is investigated whether the 'Golden Frying Pan' from 'Team Fortress 2' would be worth the high price point if it were to be used for cooking rather than in battle. It is found that a regular cast iron skillet is approximately 252 times more cost efficient and 1.34 times more energy efficient, though the golden pan has a higher thermal conductivity meaning that the heat will spread throughout the pan more evenly providing more even cooking. It is deduced that over-all the Golden Frying Pan would not be worth the investment if it were to be used as a regular cooking vessel rather than in battle.

Introduction

Besides being a typical FPS game, 'Team Fortress 2' has a complex trading economy behind it where players can exchange items such as unique weapons or in-game cosmetics for the characters. Items like these have a value agreed within the community and can be traded for real money. One of the highest valued items on the market is the 'Golden Frying Pan', this is largely due to its rarity within the game. In this paper it is explored whether buying the golden frying pan would be worthy investment if you were to use it for cooking instead of in battle.

Discussion

When looking at the model of the golden frying pan, it can be seen that it is similar to that of a skillet. Due to this the frying pan is compared to a cast iron skillet throughout the paper. The pan is also assumed to be made of solid gold so that the properties of gold can be compared to cast iron.

The first comparison to be made between the two pans is the cost efficiency. Reference [1] shows that the in-game item 'Golden Frying Pan' sells for $5679.84, this converts to approximately £4236.64 [2] (price and conversion correct as of 15 November 2021). Reference [3] shows that the cost of an example case iron skillet on the same date is £16.79. When a ratio between these costs is found, it is calculated that the golden pan costs 251.91 times more than a regular cast iron skillet.

For this significant cost increase, it would be hoped that the energy efficiency of the pan would be improved. This can be analysed using:

$$Q = mC\Delta T \tag{1}$$

Where Q is the energy needed to change the temperature of the system, m is the mass of the pan, C is the specific heat capacity of the pan and ΔT is the temperature change of the system.

To find the mass of the golden pan, the assumption is made that both pans have the same volume. The mass of the reference pan is listed to be 1.89kg [3], and the density of cast iron is

between 6800-7800 kgm^{-3} [4]. To find the volume of the pan we can use the equation:

$$V = \frac{m}{\rho} \tag{2}$$

The density for the pan is taken to be the median value of the range, giving $\rho = 7300kgm^{-3}$. Substituting these values for mass and density into equation 2 gives $V = 2.50$ x $10^{-4}m^3$.

As the assumption is made that both pans have the same volume, the mass of the golden pan can be found by multiplying the density of gold [4] by the volume. This gives the mass of the golden pan as $5.00kg$.

To calculate the energy change, a temperature change of the system needs to be defined. In this case, the system begins at $27°C$ and ends at $73°C$. This ending temperature was chosen as this is the temperature needed to fry an egg [5]. This gives an overall $\Delta T = 46°C = 46K$.

The specific heat capacity C also needs to be defined for each of the metals, reference [6] gives $C_g = 0.13kJkg^{-1}K^{-1}$ and $C_{ci} = 0.46kJkg^{-1}K^{-1}$. Substituting these values into equation 1 for each of the pans gives:

$$Q_{ci} = (1.89\ kg)(0.46\ kJkg^{-1}K^{-1})(46\ K) \tag{3}$$

$$= 39.99\ kJ$$

$$Q_g = (5.00\ kg)(0.13\ kJkg^{-1}K^{-1})(46\ K) \tag{4}$$

$$= 29.90\ kJ$$

Dividing Q_{ci} by Q_g, it is found that the golden pan takes 1.34 times as much energy to achieve the same temperature difference as the cast iron skillet, showing that it is slightly less energy efficient.

The final thing that was compared between the two pans is the thermal conductivity of each of the metals. Between -73 - $927°C$, the thermal conductivity of gold is approximately linear [7] so it can be estimated that thermal conductivity for gold at $20°C$ is $316.90Wm^{-1}K^{-1}$. Thermal conductivity for cast iron at $20°C$ is $52Wm^{-1}K^{-1}$ [7]. As can be seen, gold has a much higher thermal conductivity than cast iron at low temperatures and it can be assumed that this relationship would continue as the temperature increases to cooking temperatures. This means that if the pan was being unevenly heated, e.g., over a gas hob, the gold pan would better distribute the heat so that what is in the pan would be more evenly cooked, compared to the cast iron.

Conclusion

In conclusion, it is not really worth it to buy a golden pan over a cast iron skillet if you are planning on using it for cooking. Even though the thermal conductivity for gold is more ideal for cooking evenly, the efficiency and price outweigh the benefits from this. It is recommended to just buy a regular pan instead.

References

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