IJCRT.ORG

ISSN: 2320-2882



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

IMPACT OF THE SHAPE OF THE BOTTLE ON THE EFFECTIVENESS OF COOLING AND WARMING OF WATER





V.RITHESHWAR AND NIVEDITA



GRADE 5 SISHU GRIHA JUNIOR SCHOOL

GENESIS OF THE PROJECT





Calculation of SA

METHODOLOGY

1.4 LINES OF TRANSPORT Al Issued Connect 1 II III Different shapes of bottles Survey on shapes of bottles Orientation commonly preferred MURDER MARK the part of a THE REFERENCE A And PERSONNELLER AND PRODUCED AND THE Data Analysis for Cooling and Measurements and **Experimental Research** Warming

METHODOLOGY

- Literature survey to study the present practice
- Customer feedback for the project.
- Select plastic bottles of different shapes (round, square, decagonal, octagonal and rectangular) ICR.
- Estimate the surface area of the bottles
- Experimentally study the rate of cooling in the refrigerator

The rate at which water gets warmer outside the refrigerator with the help of a mobile timer and digital temperature measuring instrument



METHODOLOGY

- Analyse the data for observing cooling and warming trend with change in shape of the bottles
- Demonstrate the concept and the findings to the customers





IJCRT21X0054 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org d742

CALCULATION OF SURFACE AREA

Octagonal Surface Area

One side was measured using a sheet of Adhesive Paper which was measured using a scale and cut accordingly. Then it was multiplied into 8. Total Surface Area= Surface area of one strip x 8 = 22cm x 3.3cm x 8 = 72.6cm x 8 = 580 sq.cm



IJCRT21X0054 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org d743

CALCULATION OF SURFACE AREA

Round Surface Area

The surface area of the bottle was found by Wrapping it with a sheet of paper and measuring its length and breadth Length of the sheet =19.2cm

Breadth of the sheet= 24 cm Surface area =19.2x24

= 460.8 sq.cm



EXPERIMENTATION (SetI)

COOLING			WARMING					
Time(minutes)	Round (Temperature) 24.43	Square (Temperature) 24.3	Octagon (Temperature) 23.9	-	Time	Round	Square	Octagon
60 120	20.13 18.1	19.67 16.27	<u>18.77</u> 15.57		(minutes)	(Temperature) 10.07	<u>(Temperature)</u> <u>10</u>	9.93
120 180 240	14.77 13.13	13.9 12.7	13.63 11.7		150 240	<u>16.93</u> 20.17	17.5 20.1	17.43 20.9
300 360	<u>11.6</u> <u>10.97</u>	11.53 10.93	10.9 9.87		270	<u>21.43</u> 22.33	<u>21.7</u> 22.5	22.03 22.93
420	<u> </u>	9.93			390	22.43	23.37	23.8

Round	Square	Octagon
31.54	29.23	25.66
750	750	750
427.04	522.5	580
	Round 31.54 750 427.04	Round Square 31.54 29.23 750 750 427.04 522.5

Average Rate of warming minutes/deg.C)	Round	Square	Octagon
	31.55	29.17	28.12
Volume of Bottle-ml	750	750	750
Lateral Surface Area(cm square)	427.04	522.5	580

Outcome:

1. Octagonal shaped bottle proves to be the best 1. Square and octagonal shaped bottles keep water cooler

IJCRT21X0054 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org d745

option for cooling water.

2. Round shaped bottles yields lowest cooling

for longest rates. time as compared to other shapes.

for shorter time than round shaped bottles

2. Round shaped bottles retains cold water



GRAPHICAL REPRESENTATION (Set-I)





EXPERIMENTATION (SetII)

COOLING			WARMING					
Тетр	Round Time(minutes)	Square Time(minutes)	Rectangle Time(minutes)		Temp (minutes)	Round (Temperature)	Square (Temperature)	Rectangular (Temperature)
26	0	0	0		12	0	0	0
24	10	16	23		14	11	6	11
27	22	21	43		16	22	17	25
			43		18	36	28	43
20	65	55	56		20	55	43	65
18	104	79	83		22	82	65	97
16	153	127	182		24	108	86	170
14	251	153	288		26	151	155	228
12	439	260	468		28	257	210	321
						9		

Average Rate of cooling(minutes/deg.C)	Round 31.36	Square 18.57	Rectangle 33.43	
Volume of Bottle-ml	1000	1000	1000	
Lateral Surface Area(cm square)	494	635	448	

Average warming Rate(minute/deg.C)	Round 16.06	Square 13.13	Rectangle 20.06
Volume of bottle-ml	1000	1000	1000
Lateral Surface areacm square	494	635	448

IJCRT21X0054 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org d748

www.ijcrt.org	© 2022 IJCRT Volume
Outcome:	Outcome:
 Other shaped bottles with lower surface area take comparatively much Rectangular and round shaped bottles keep water cool for a longer time longer time for cooling as the surface area is lower than square shaped bottle 	
2. Square shaped bottle appear to be the best option for cooling water.	
3. Further trials are required to confirm the above findings.	

GRAPHICAL REPRESENTATION (Set-II)





IJCRT21X0054 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org d750

CLUSION

ANALYSIS OF THE RESULTS AND CON

Based on 14 activities conducted so far with different shapes of bottles the following conclusions have been drawn:

1. Round shaped bottle filled with water results in the slowest cooling rate.

2.Octagonal shaped bottles filled with water result in the fastest cooling rate.

3.Cooled water stored in round shaped bottles maintain water cooler for a much longer time than Octagonal shaped bottles.

4.Cooled water stored in octagonal shaped bottles maintain water cooler for a much shorter time than round shaped bottles.

5.Lateral Surface area is a vital factor for heat exchange with surroundings. Larger the surface area for the same volume, faster is the heat exchange.

(Experiments were conducted for two sets. One set was conducted at Chennai and another set was conducted at Bangalore. No. of trials conducted at Chennai is inadequate presently to draw conclusions and hence further trials are being planned.)

SIGNIFICANCE AND IMPACT

Our findings are in alignment with practical day to day applications as mentioned below:

- Octagonal Bottle has a greater surface area and hence cools faster than round shaped bottles
- But the cylindrical bottle having the least Surface area maintains water cool for a much longer time.
- Hence the conventional practice of using the shape of the bottle for cooling water and for keeping it cool outside is not recommended.

We must use bottles with larger surface area for cooling water and bottles with minimum area for maintaining it cool outside. **CUSTOMER FEEDBACK**

Some Samples of Customer Feedback

- The work done is an excellent demonstration of the fact that heat transfer is proportional to surface area given the same experimental conditions.
- The experiment, proved a thought of the relationship between surface area and cooling which we usually never consider in our day to day aspect. Good invention to adapt in daily needs.

• This project is helpful in our day-to-day life for everyone. Please update once the result has been published. All the best



LITERATURE SURVEY

1.<u>https://www.newlearn.info/packages/clear/interactive/matrix/level_11_surface_area_to_volume</u>_ratio.html#:~:text=The %20surface%20area%20to%20volume%20(S%2FV)%20ratio%20

- 2. <u>https://en.m.wikipedia.org</u>/wiki/Surface-area-to-volume_ratio
- 3. <u>https://csef.usc.edu/History/2011/Projects/S1824.pdf</u>

4.<u>https://www.quora.com/What-is-surface-area-to-volume-ratio-and-what-role-does-it-play-in-differentapplications-like-heat-transfer/answer/Aditya-Pathak-1?ch=15&oid=9215477&share=48558134&srid=uoX3J&target_type=answer</u>

- 5. <u>https://www.academia.edu/6746861/COOLING_EFFECT_BOTTLES</u>
- 6. <u>https://www.thomasnet.com/articles/materials-handling/types-of-water-bottles/</u>
- 7. <u>https://thermtest.com/stay-colder-for-longer-in-a-container-made-of-plastic-or-metal</u>
- 8. <u>https://www.postharvest.net.au/postharvest-fundamentals/cooling-and-storage/cooling-rates/</u> IJCRT21X0054 International Journal of Creative Research Thoughts (IJCRT) www.ijcrt.org d756