Industrial Design

P2 Project.

Redesign of a Reusable water bottle

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Approval Form

This is to certify that the Industrial Design Project entitled
“Re-design of an water bottle for better handling” by Malhar Pilvalkar is approved for partial fulfillment for the Master of Design degree in Industrial Design.

Prof. B.K. Chakravarthy [Project Guide]:

Signature of the Chairperson:

Signature of the Internal Examiner:

Signature of the External Examiner:

Acknowledgement

I, Malhar Vinay Pilvalkar declare that this written report represents my ideas in my own words, and where others' ideas or words have been included I have adequately cited and referenced the original sources.

I also declare that I have adhered to all principles of academic honesty and integrity and have not falsified, misinterpreted or fabricated any idea, data, facts or source in my submission.

I understand that any violation of the above will be caused for disciplinary action by the Institute and can also evoke penal action from the source, from which proper permission has not been taken or improperly been cited.

Malhar Pilvalkar
206130009

Acknowledgement

I would like to use this opportunity to give thanks to those who
helped me going through this Course project. I would like to extend my respect to all the people who helped me in accomplishing this task.

First, I would like to thank my Course Guide, Mr. B.K. Chakravarthy, for being extremelyhelpful.

.
I also extend my gratitude towards all my friends who inspired and supported me in all possible ways in this semester journey.

I also want to offer my appreciation towards IIT Bombay for all the help and facilities they have provided.

Abstract

This is a College course project in an effort to understand the Design Process that is followed to redesign any product for general consumers.

The topic selected for the project was the Redesign of a reusable everyday water bottle for young indian user. The Concise brief
can be Quoted as “To Design a range of water bottle for Young age groups keeping in mind usability,Handling portability, ergonomics, aesthetics,visual semantics as features."

The issues targeted were selected based on interviews that were conducted during the project.

Disposable plastic water bottles contribute a major part in global plastic pollution. Reusable plastic bottles are a significant counter majors to this problem.

After pandemic people have become more conscious about health and fitness. Reusable water bottles are one of the products used by wide user groups involved in sports and fitness.

Disposable packaged drinking water bottles are one of the major reasonsof plastic related pollutants.

Use of reusable water bottles helps in countering this issue.

Source

A safe water supply is the backbone of a healthy economy, yet is woefully under prioritized, globally.

It is estimated that waterborne diseases have an economic burden of approximately USD 600 million a year in India.

This is especially true for drought- and flood-prone areas, which affected a third of the nation in the past couple of years..

Less than 50 per cent of the population in India has access to safely managed drinking water. Chemical contamination of water, mainly through fluoride and arsenic, is present in 1.96 million dwellings.

Source

Water Sources And Contaminations

The water we drink comes from different sources, which are influences by various factors. Hence they have different types and levels of contaminations.

Pond / Lake

Rain Water

Ground Water

River Water

Reservoir

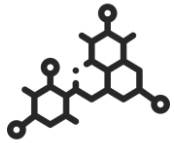
Municipal authority collects and purifies water for distribution. After this water interacts with unclean pipes and tanks which may result into contamination.

What are the Types of *Contamination* ?

Water sources can get polluted because of a range of harmful contaminants. The common contaminants occurring in drinking water can be classified into

Inorganic contaminants:

include metals such as fluoride, arsenic, lead, copper, chromium, mercury, antimony, cyanide



Organic contaminants

include pesticides, untreated domestic and industrial wastes etc.

Biological contaminants

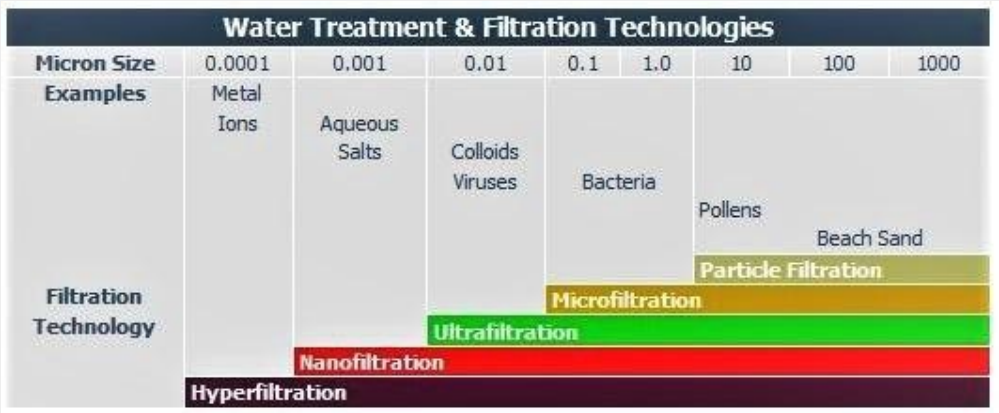
include the presence of living organisms, such as algae, bacteria, protozoa or viruses in the water.

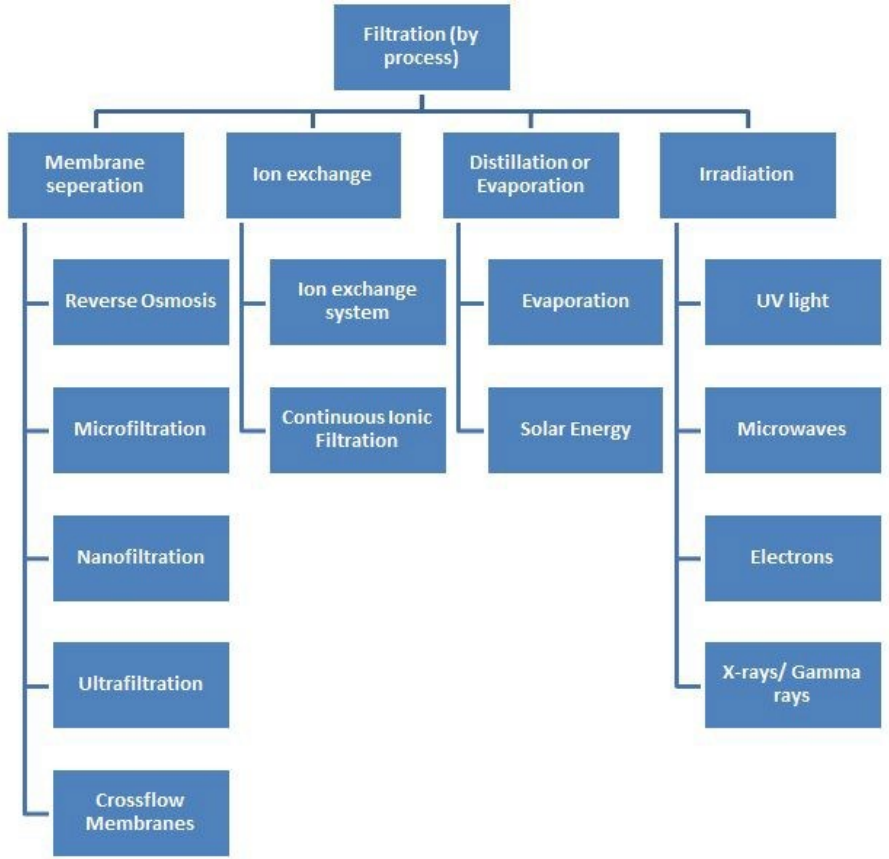
Radiological contaminants

include radioactive materials that are found naturally in the soil or rocks or generated through industrial wastes.

Types of Filtration Methods

Based on properties like size, chemical composition; various filtration techniques are effective on particular type of contaminants.





Water Bottles

Current User Concerns

Bottle slipping from hand
Mobility
Discomfort while handling
Stability on surface
Durability
Leakage
Cleaning
Extensive head tilting
Difficulty in refilling
Forgetting or losing
Empty Weight
Aesthetics

Possible areas of Interventions

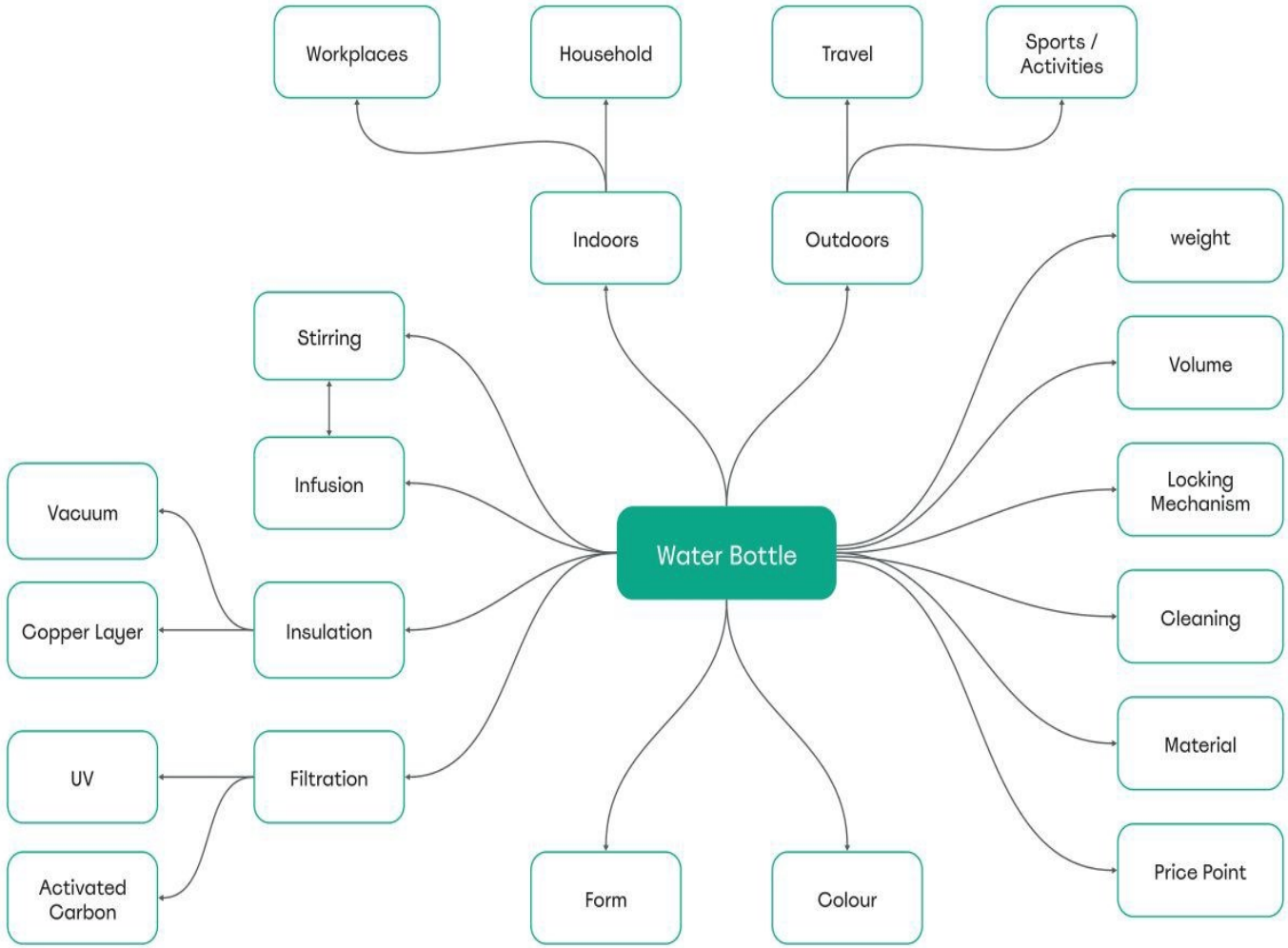
Better Grip
Smart features
Filtration
Hydration Assistance
Cleaning
Stability
Empty Weight
Temperature Insulation
Better Materials
Leakage Prevention
Modular Lids / accessories
Storage / Volume

Initial Design Brief

To design a reusable water bottle for young age group of 20 to 30; keeping in mind better usability and Aesthetics.

Research

MindMapping



How Did Ancient Civilizations Get Water?

Hunter-gatherers had to be creative and find ways to get fresh water that was free of contamination.

The first written account of water being purified came from Greek texts from around 4000 BC. They would filter their water through charcoal and expose it to sunlight to remove any harmful pathogens.

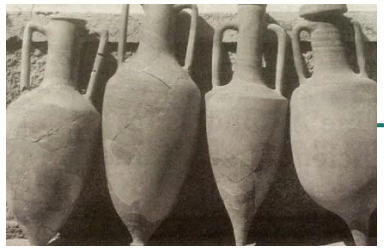
In the first "urban" area of Jericho, people would acquire water from springs and transport it using wooden buckets, clay urns, or metal flasks.

By the Medieval Era, hunters crafted waterskins from leather or animal hide. These could easily be brought with on long travels by horseback and were also strong enough to withstand inclement weather conditions.

Overall, crops, animals, and people wouldn't have been able to survive without water. It's always been important for us as a society to find a way to keep it clean and carry it around.

Source

large casks or urns



4000 BC

Animal Hide

1070

Clay-Stone Bottles

1800s

Glass Bottles

1900s

Enameled Steel

1914 - 1945

1947

Plastic

1940s -1950s

Aluminium

1950s

Stainless Steel

1960s

Polyethylene

1964

Characters

1960s-1990s

Branding

Source

Promotional products

1985

Cyclist Bottles

1994

High End Coolers

2006

Designer Approach

2010

2016

Smart Features

2018

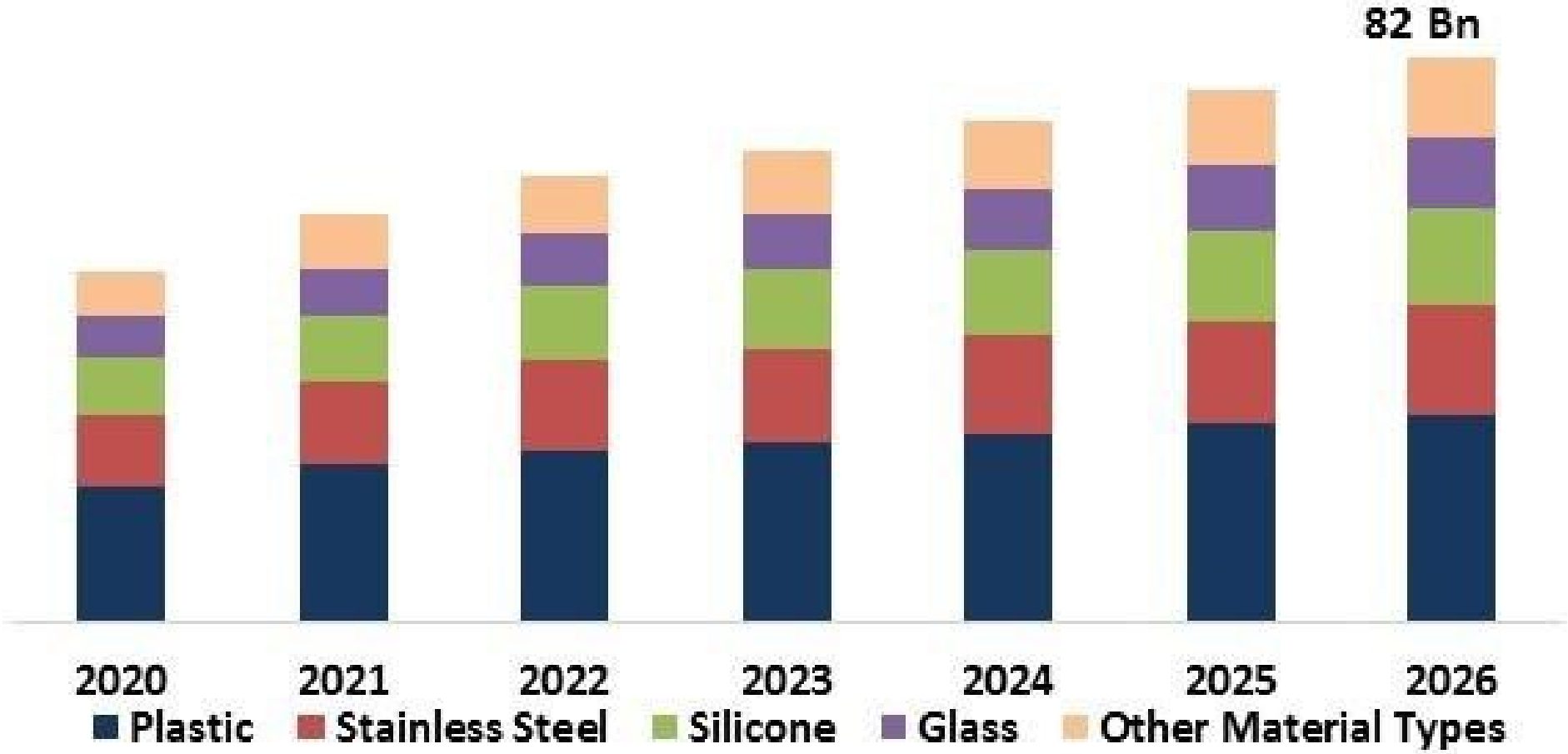
Eco Friendly

2020

SelF Cleaning

Source

Reusable Water Bottle Market Size by material type



Market Study For Water Bottles With Filtration Features

Typical Sizes in Water Bottles

Understanding Safety

BPA is comparable to estrogen and can trigger the response of human hormones. It is an natural compound containing two phenolic useful bunches and could be a crude fabric and added substance for a few critical polymers. BPA has numerous applications. It can be utilized in a few polymers such as polyester, polysulfone, and polyether ketone. It can moreover be included as an antioxidant and a solidifying inhibitor to plasticizers. It can moreover be utilized as a polymerization inhibitor. Include to PVC. BPA is additionally an critical monomer for PC and epoxy gums. PC plastic is straightforward and safe to drop, and is broadly utilized in numerous buyer items such as drinking glasses, infant cutlery, sports hardware, restorative equipment, optical plates and family machines. Epoxy tars are commonly utilized within the internal coating of a few nourishment and refreshment cans.

BPA shows hormone-like properties that raise concerns about consumer products and the use of food containers. Governments in some countries have investigated their safety since 2008, prompting some retailers to withdraw from polycarbonate products. The US Food and Drug Administration (FDA) report in 2010 suggested that BPA may be harmful to the fetus, infants and children, but the report confirms that very low concentrations in certain foods are safe. In September 2010, Canada became the first country to declare BPA toxic substances. The EU, Canada, and the United States have banned BPA use in baby bottles.

BPA is toxic, and long-term inhalation of BPA powder is harmful to liver function and kidney function; especially serious, it reduces the amount of hemoglobin in the blood.

Source

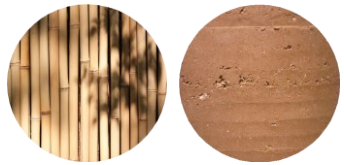
Understanding materials

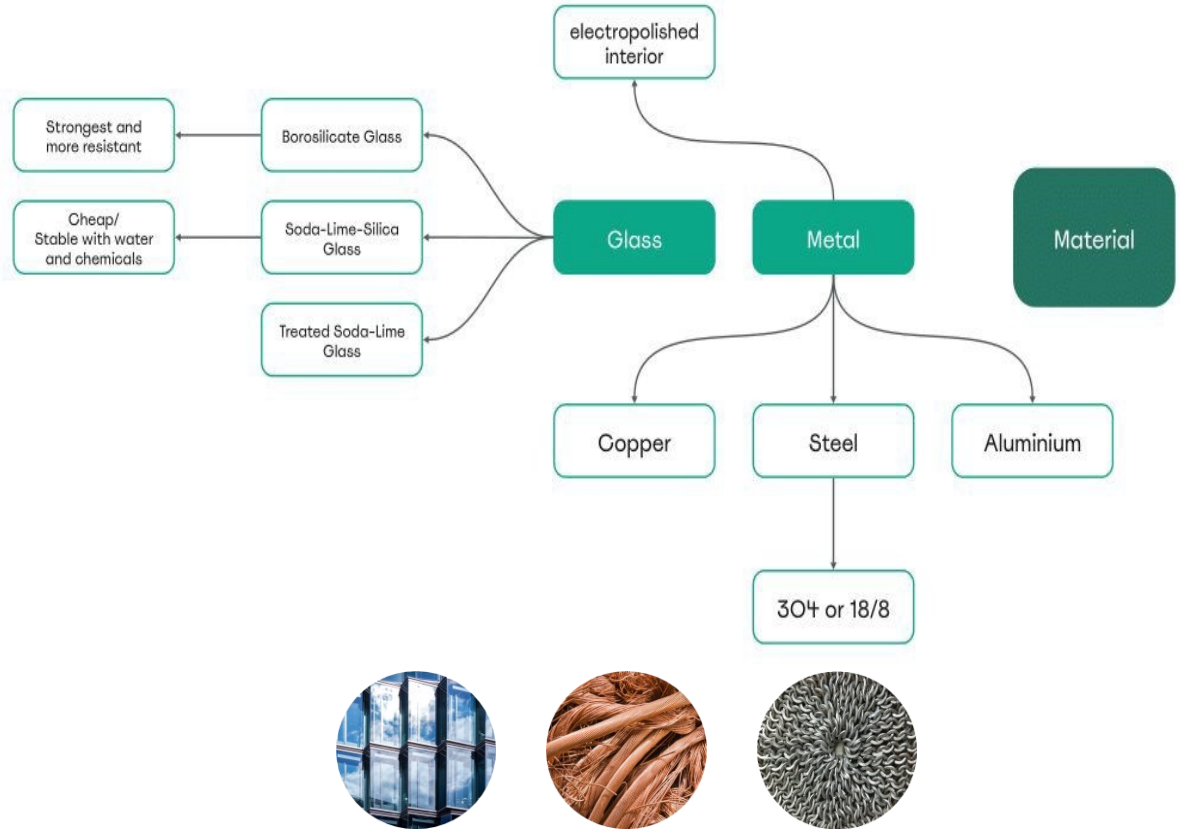
There are numerous choices on the showcase for reusable water bottles. Regularly, reusable water bottles are made of copolyester, polycarbonate, polyethene, polypropylene, biodegradable bioplastics, stainless steel, aluminum, glass and ceramics. . There are some glass producers and retailers that can reuse water bottles. The foremost solid bottles are made of stainless steel and aluminum.

But we think the foremost vital thought is that water is securely put away within the bottle – no chemicals are leached from the container.

In the past few long time, the most concern has been chemicals, BPA, which may be a key fixing in polycarbonate plastics and epoxies. Until some long time prior, numerous plastic nourishment and water/beverage holders were made of plastic. These plastics all contain BPA. Bisphenol A (BPA) could be a component that's frequently found in plastic items. Estrogen that can obstruct chemical modelling and brain and regenerative improvement that can hurt the embryo, newborn child, and child.

Understanding materials





Understanding materials

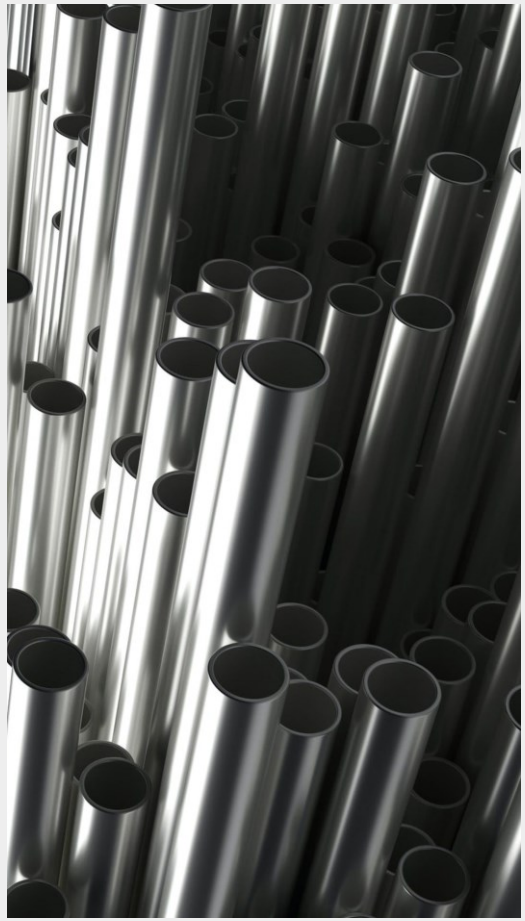
Main Materials for Reusable ECO-Friendly Water Bottle							
	Material	**BPA Free**	**Suitable for Hot Beverage**	**Suitable for Cold Beverage**	**Suitable for Outdoor or Sports**	**Durable**	**Remark**
Metal	Stainless Steel (grade 304)	Yes	Yes	Yes	Yes	Yes	Most Recommended
	Aluminum	Yes	Yes	Yes	Yes	Yes	Aluminum is harmful for health
Plastic	Tritan	Yes	No	Yes	Yes	Yes	Recommend if no hot drinks
	PP	Yes	Yes	Yes	Yes	Yes	
	PETG	Yes	No	Yes	Yes	Yes	
	Biodegradable Plastic	Yes	No	Yes	Yes	Yes	
Others	Glass	Yes	Yes	Yes	No	No	Recommend if no outdoor or sports using
	Ceramics	Yes	Yes	Yes	No	No	Recommend if no outdoor or sports using

Source

Understanding materials : Stainless steel

Stainless steel is an alloy, resistant to tarnishing and rust, stainless steel is made of some of the most basic elements found on Earth: iron ore, chromium, silicon, carbon, nitrogen, and manganese. There are more than 57 types of stainless steel recognized as standard alloys.

To be recognized as stainless steel, the composition must have a minimum of 10.5% chromium content by mass and a maximum of 1.2% carbon by mass. Chromium is the element that gives stainless steel its famous corrosion resistance.



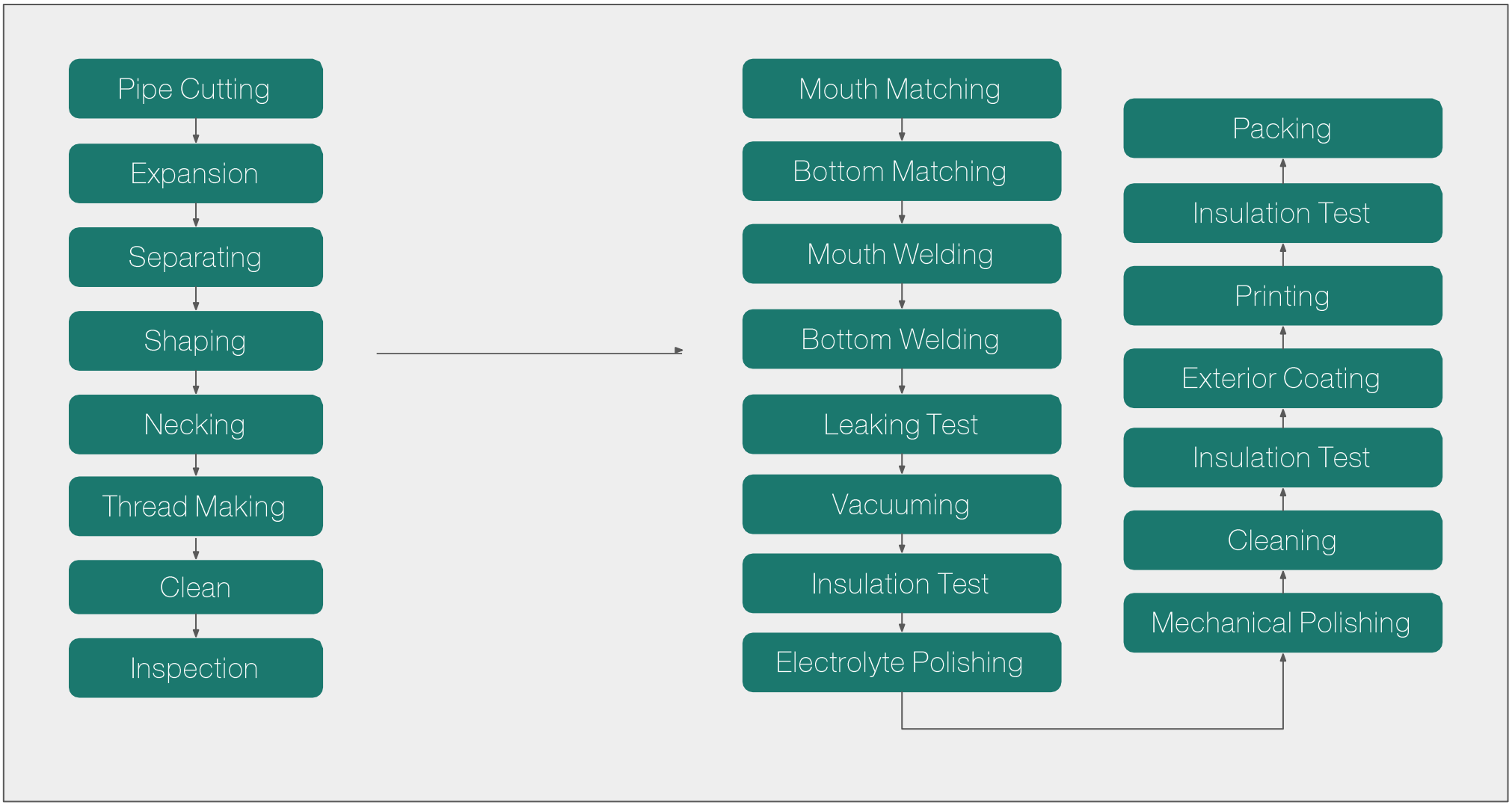
Source

Understanding materials : 304 Stainless Steel

- Also known as “18-8” stainless steel, because it contains 18% chromium and 8% nickel.
- It accounts for more than 50% of all stainless steel produced.
- 304 can withstand corrosion from most oxidizing acids. This durability makes it easy to sanitize, and therefore ideal for many kitchen and food applications.
- It also has good forming and welding properties, allowing it to be manufactured into a variety of shapes.
- One of 304’s biggest weaknesses is its susceptibility to corrosion from chloride solutions, or from saline environments such as saltwater

Source

Understanding Manufacturing Process: Stainless Steel Bottle



Understanding Manufacturing Process: Stainless Steel Bottle

Inner Bottle Production Process

Outer Bottle Production Process

Outer + Inner Bottle Production Process

Tritan Copolymer

"Accredited universities and independent third-party labs tested Tritan, and the results overwhelmingly demonstrate that it is safe and, in separate studies, free of bisphenol A (BPA) and bisphenol S (BPS). Tritan plastic also is free of estrogenic activity (EA) and androgenic activity (AA)."

Tritan is a copolyester plastic that's manufactured exclusively by a company called Eastman. It's very similar to other polycarbonate plastics (it's very hard, durable, and impact-resistant), but it's made without any BPA, BPS, or other bisphenols.

Tritan plastic is the safest plastic in the world. Not only is Tritan BPA-free, but it is also free from BPS (bisphenol S) and ALL other bisphenols. Certain Tritan plastics are also considered medical-grade, meaning they are approved for use in medical devices.

Tritan plastic has also been approved for use in food contact applications all over the world by the following regulatory agencies:

- U.S. Food and Drug Administration
- Health Canada
- European Food Safety Authority and European Commission
- China's Ministry of Health
- Japan Hygienic Olefin and Styrene Plastics Association
- NSF International

Source

Tritan Copolymer: Advantages

1) BPA free

Tritan has no BPA in the polymerization process and does not release BPA during use, meeting environmental requirements and the FDA.

2) Clear and transparent

Light transmittance >90%, haze <1%, crystal-like luster.

3) Excellent impact strength

There is no gap impact, and the notched impact strength is between 650-980J/m due to the grade, which is comparable to the impact strength of PC.

4)Excellent resistance to hydrolysis and hydrolysis

Tritan is resistant to corrosion by detergents, detergents, hydrocarbon solvents, oils, perfumes, etc.; it is resistant to hydrolysis in hot, humid environments.

5). High temperature resistance

The low pressure heat distortion temperature (HDT@ 0.455MPa) is between 94 °C and 109 °C depending on the grade.

6) Good mobility

The test conditions are 2.16 kgf pressure and 280 ° C melt temperature. The melt index (MI) is between 15.3 and 29.5 depending on the grade.

7) Easy molding processing

Tritan's grades can be processed by various methods such as injection molding, extrusion, extrusion (EBM), and injection blow molding (ISBM). In general, molds that can be produced normally using PCs can be produced with Tritan? without modification, and the production cycle times are very close.

8) Easy secondary processing

The secondary processing methods that Tritan can be applied to include: UV glue bonding, ultrasonic welding, surface printing, surface vacuum plating, etc.

9) Small residual stress of the product

After injection molding, the residual stress of the product is smaller than that of PC, and no subsequent annealing is required. Tritan manufactures products that are more durable due to less chance of cracking due to residual stress during use.

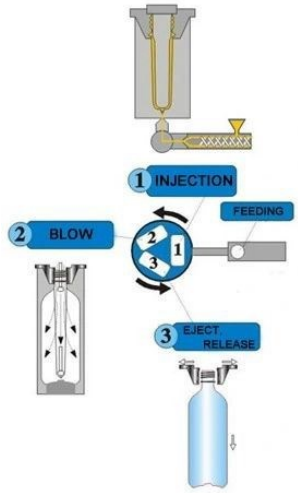
Source

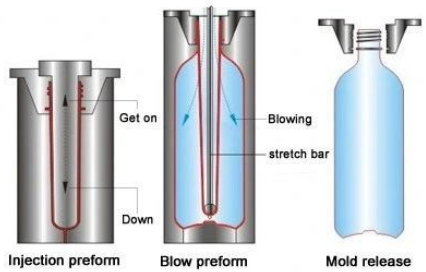
Tritan Copolymer: Manufacturing

For Tritan products, as for traditional PET, in order to produce aesthetically perfect containers, the ideal is a single stage process, i.e. to make use of a line designed to carry out the entire ISBM (Injection Stretch Blow Moulding) process in a single cycle, maximising, among other things, the cleaning aspect, as well as production quality.

The material is first dried, before passing on to the processing machine. In the extruder, the granules are heated and plasticized. The molten material is then injected into the injection mould to create the preform.

Subsequently, in a second step, the preforms are inserted into a stretch-blowing machine where the blowing mould allows passage from the initial preform to the final shape. It is in this phase that all the types of shape and engraving are created.

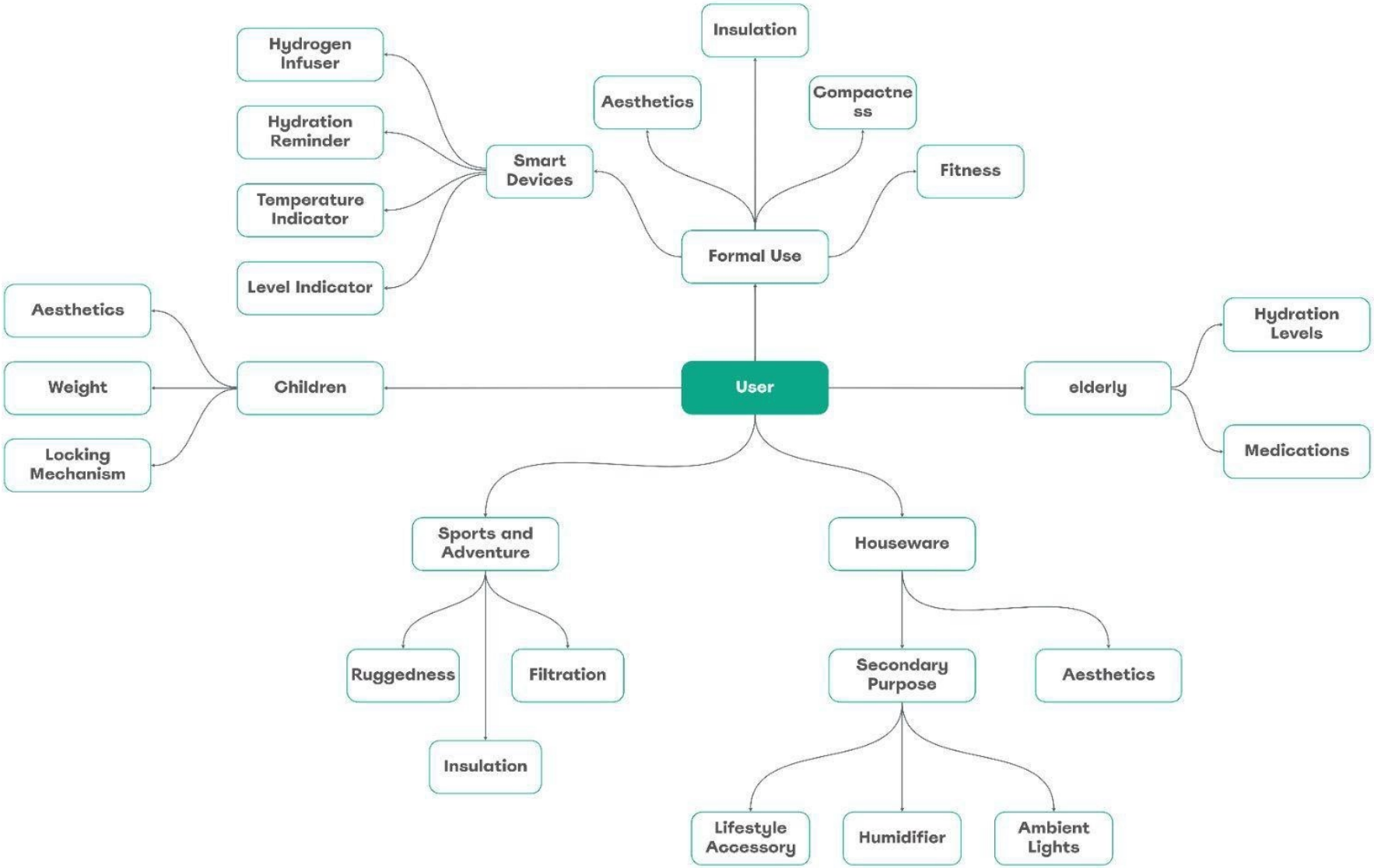


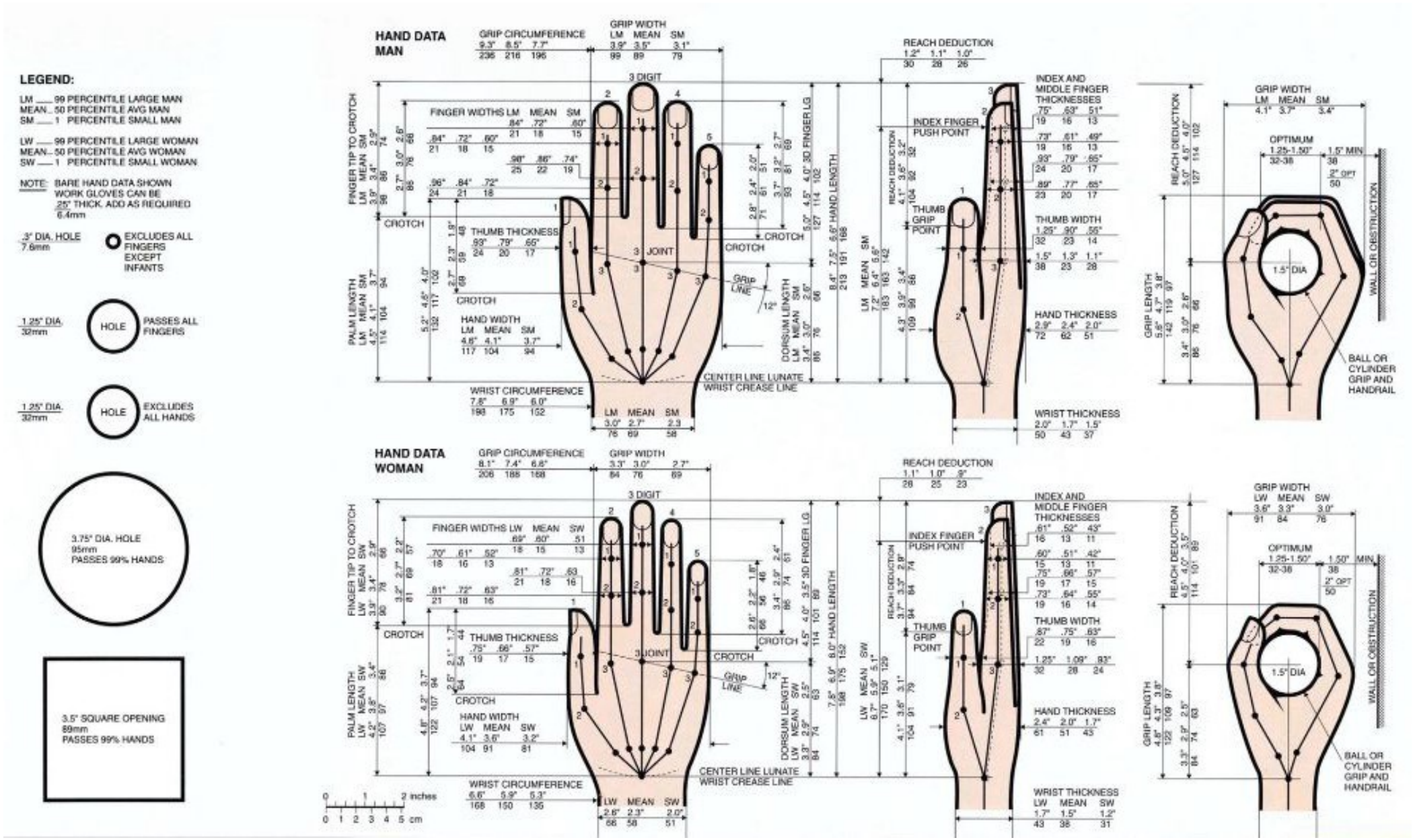


Processing Melt Temperature	270-285°C (520-545°F)
Injection Mold Temperature	60-70°C (140-160°F)
Preform Temperature at Blow	185-195°C (365-385°F)
Primary Blow Pressure	0.03-0.08 MPa (4-12psi)
Secondary Blow Pressure	0.2-0.3 MPa (25-40 psi)
Blow Mold Temperature	80-90°C (175-195°F)
Residual stress under polarized light, Fringe Count	EMN <= 3

Source

Understanding the **User**


Hydrogen Infuser
Hydration Reminder
Temperature Indicator
Level Indicator
Smart Devices
Insulation
Aesthetics
Compactness
Fitness
Formal Use
Aesthetics
Weight
Locking Mechanism
Children
User
elderly
Hydration Levels
Medications
Sports and Adventure
Houseware
Ruggedness
Filtration
Insulation
Secondary Purpose
Aesthetics
Lifestyle Accessory
Humidifier
Ambient Lights


LEGEND:
LM ___ 99 PERCENTILE LARGE MAN
MEAN_ 50 PERCENTILE AVG MAN
SM ___ 1 PERCENTILE SMALL MAN
LW ___ 99 PERCENTILE LARGE WOMAN
MEAN_ 50 PERCENTILE AVG WOMAN
SW ___ 1 PERCENTILE SMALL WOMAN
NOTE: BARE HAND DATA SHOWN
WORK GLOVES CAN BE .25" THICK. ADD AS REQUIRED 6.4mm
.3" DIA. HOLE 7.6mm
EXCLUDES ALL FINGERS EXCEPT INFANTS
1.25" DIA. 32mm
HOLE
PASSES ALL FINGERS
1.25" DIA. 32mm
HOLE
EXCLUDES ALL HANDS
3.75" DIA. HOLE 95mm PASSES 99% HANDS
3.5" SQUARE OPENING 89mm PASSES 99% HANDS
HAND DATA MAN
GRIP CIRCUMFERENCE
GRIP WIDTH
REACH DEDUCTION
3 DIGIT
FINGER WIDTHS
FINGER TIP TO CROTCH
THUMB THICKNESS
JOINT
CROTCH
PALM LENGTH
HAND WIDTH
WRIST CIRCUMFERENCE
DORSUM LENGTH
3.5" 3D FINGER LG
HAND LENGTH
CENTER LINE LUNATE WRIST CREASE LINE
INDEX AND MIDDLE FINGER THICKNESSES
INDEX FINGER PUSH POINT
THUMB GRIP POINT
THUMB WIDTH
HAND THICKNESS
WRIST THICKNESS
GRIP LENGTH
OPTIMUM 1.25-1.50"
1.5" MIN
2" OPT
1.5" DIA
WALL OR OBSTRUCTION
BALL OR CYLINDER GRIP AND HANDRAIL
HAND DATA WOMAN
0 1 2 inches
0 1 2 3 4 5 cm

User Persona

Name: Narayani Prabhu

Age: 28

About:
Narayani is literature scholar at university. When not reading she enjoys spending her time in practicing yog and Bharatanatyam.

Name: Chaitanya Wagh

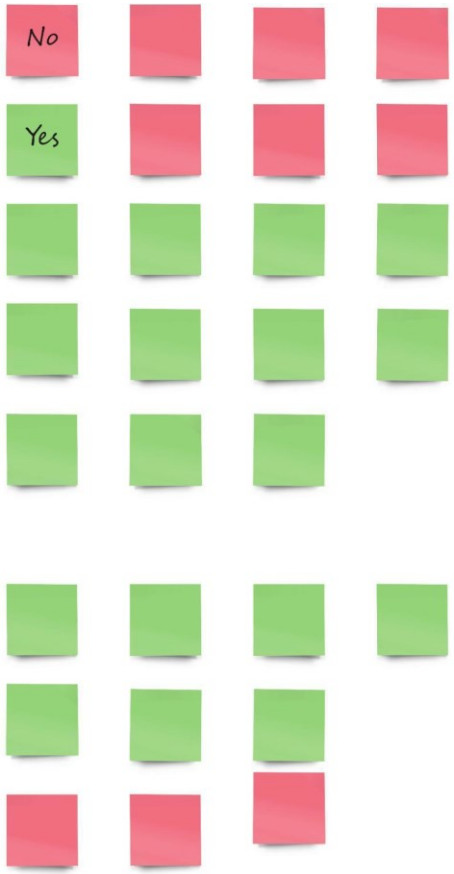
Age: 27

About:
Chaitanya works as software engineer. On weekends he runs away to mountains and forts for trekking.

User Survey

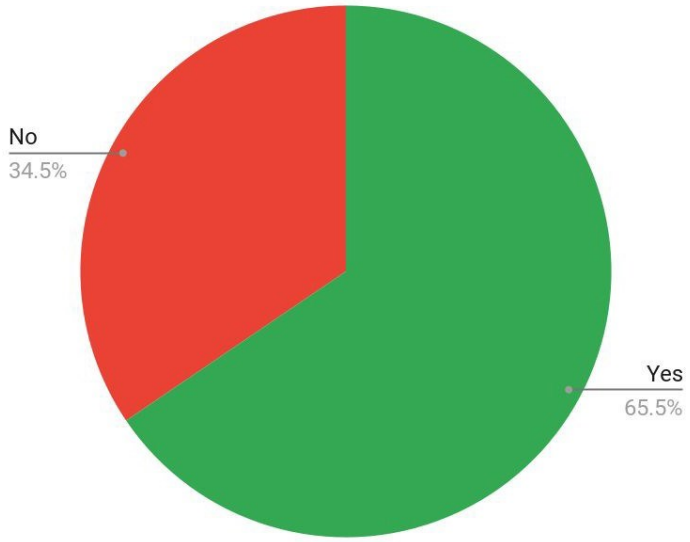
A online survey was conducted with 30 people. The user group was Indian, young and involved in some kind of physical activity like sports. Inputs were taken about their activity patterns, usage of reusable water bottles, perception about public water sources etc.

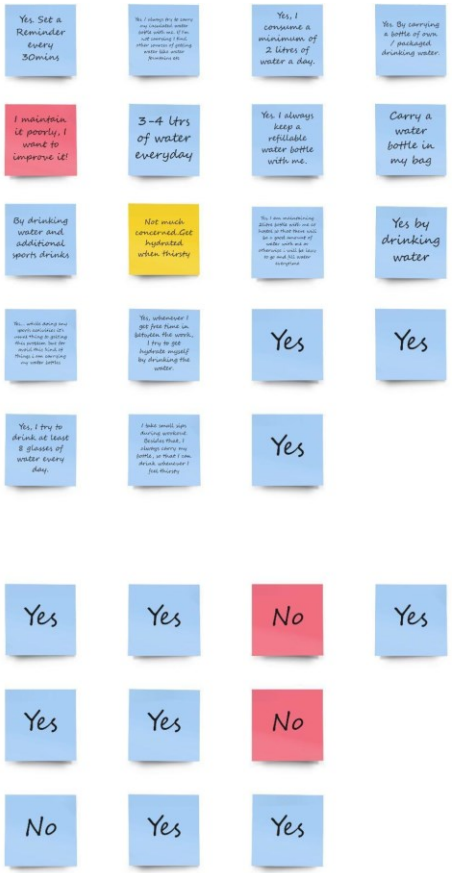
These inputs are further analysed to decide design directions.



Involvement in physical Activity, Sports, Yog etc

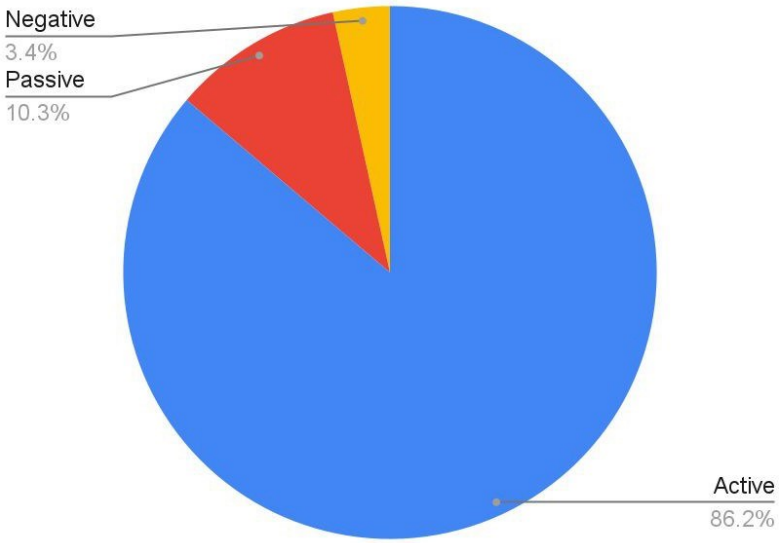
Most of the users are practicing at least some type of physical activity





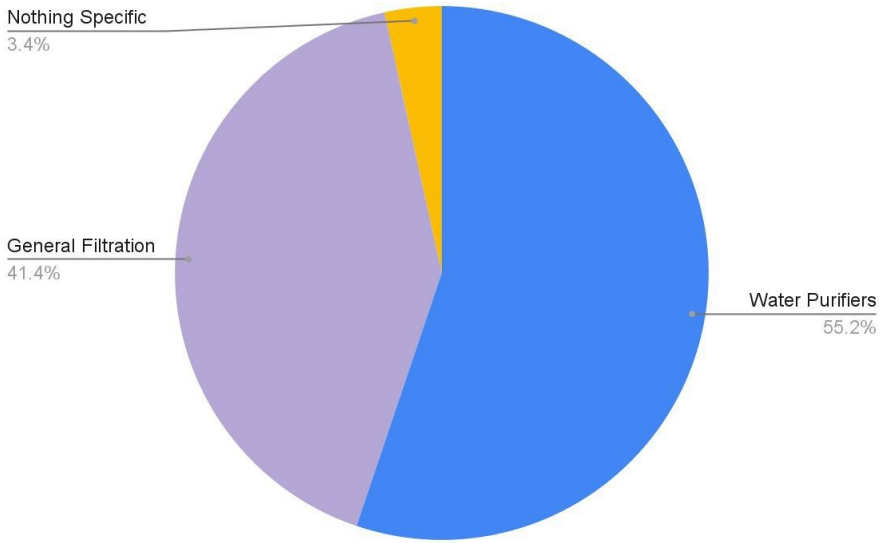
Concerns about personal hydration levels

86.2 % Users are concerned and are actively monitoring their hydration levels via various methods. This makes a scope for a feature



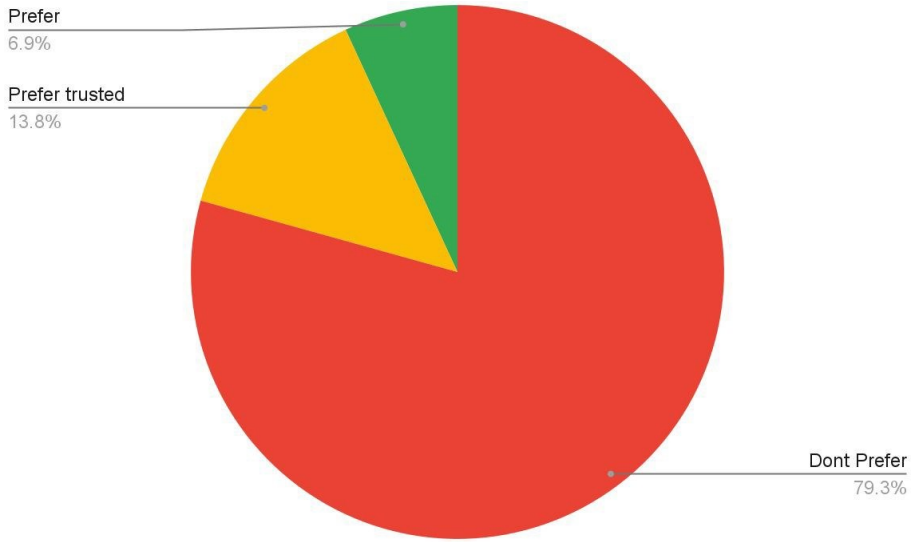
Use of filtration techniques

Prominent group of user rely on water purifiers and other filtration techniques for their drinking water quality.



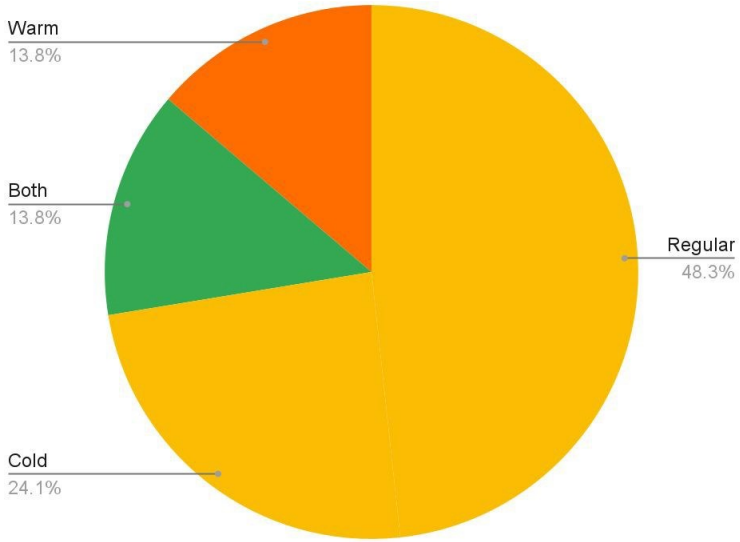
Perception about drinking water sources at public spaces

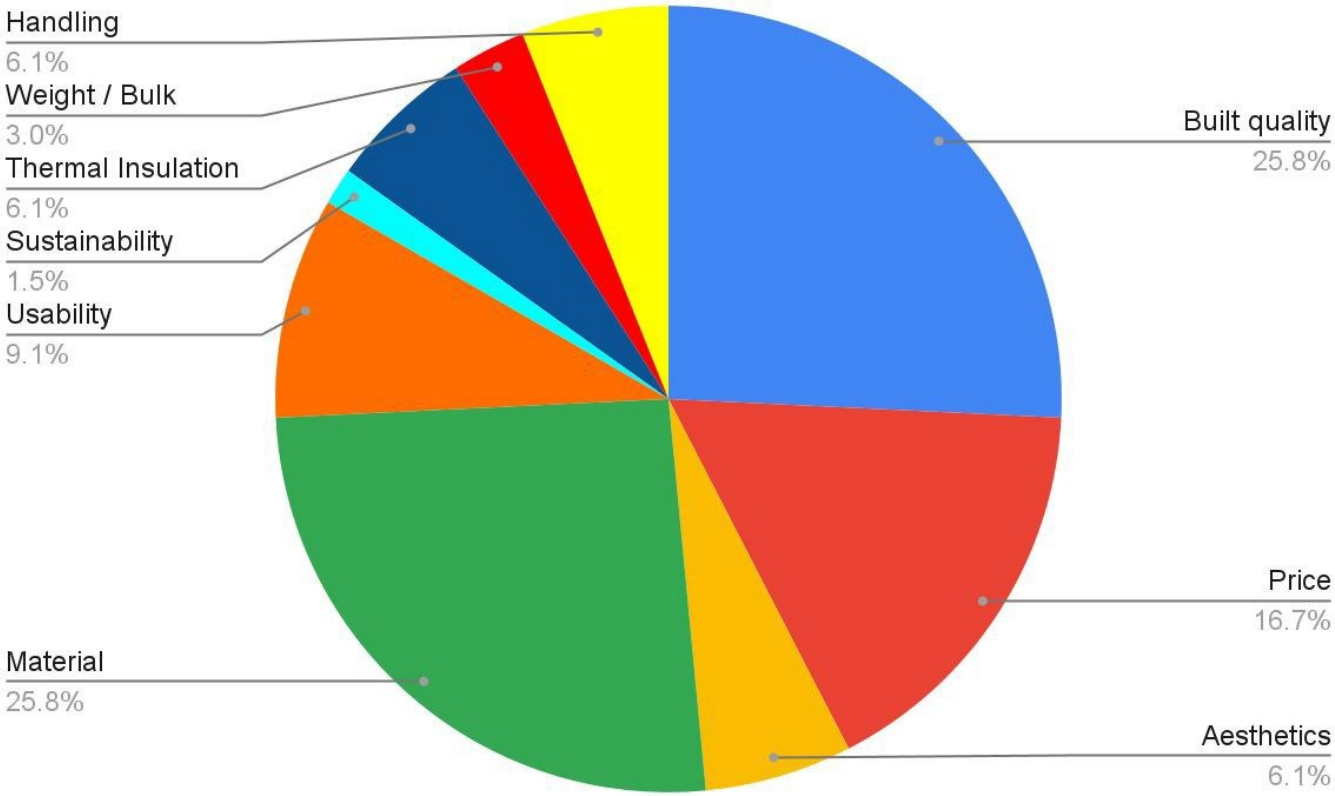
Around 94% users don't trust unknown water sources and mostly end up buying single use packaged drinking water.



Temperature preferences for drinking water

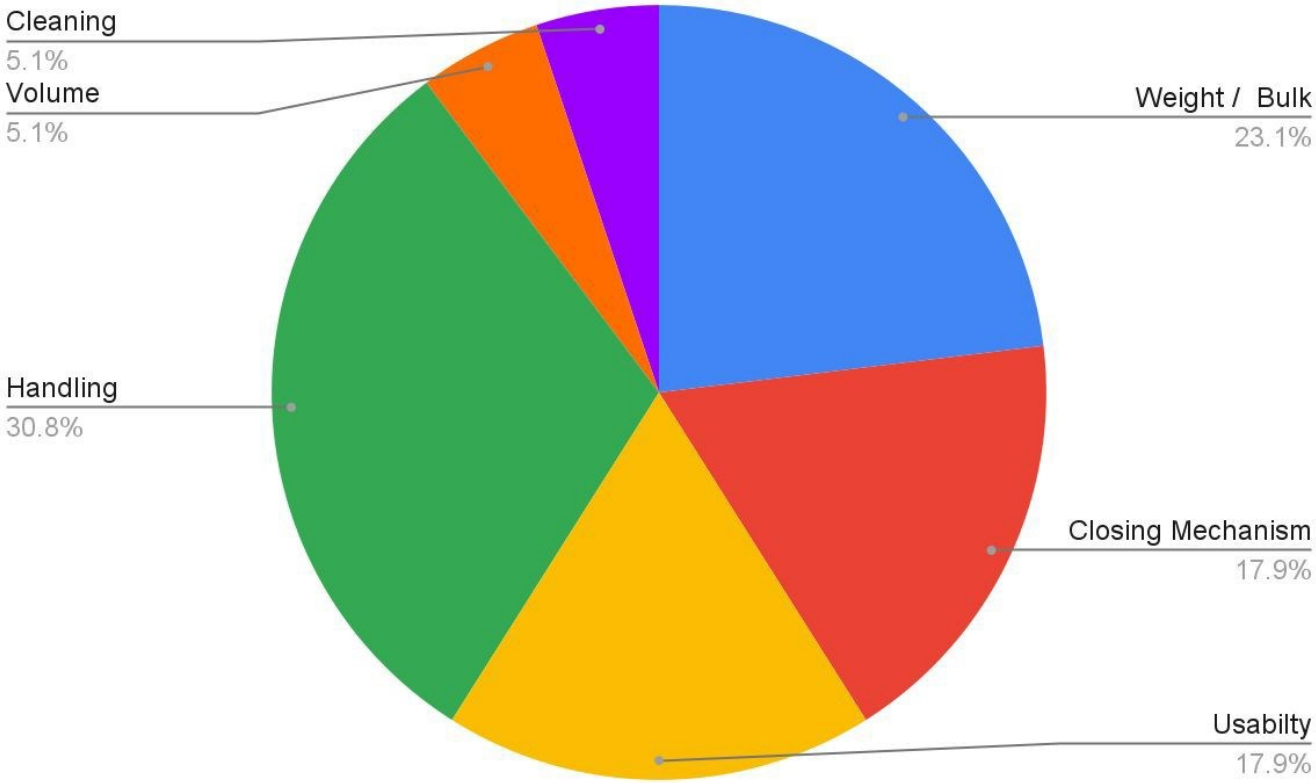
Majority of users prefer room temperature water but there is always a desire for insulated drinkware for outdoors





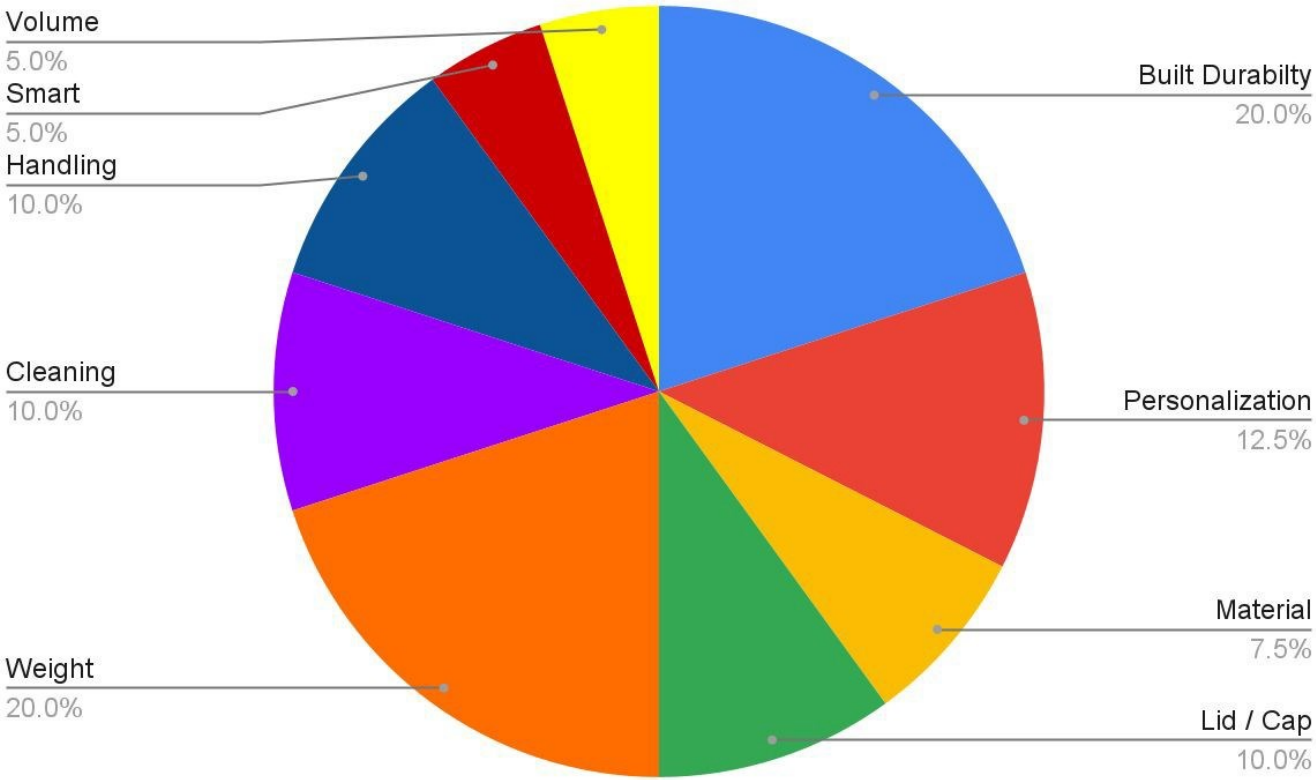
Buying Criterias

Following are various purchase consideration mentioned by users.



User Experiences and Pain Points

Helped to understand design directions.



Customer Desires

This helped to understand what user wants apart from pain points.

Insights and directions for design interventions

- Form to manage Bulk and Weight of the product.
- Details of Lid /Cap /closing Mechanisms
- Handling, Carrying bottles on the go
- Easy to cleaning and maintenance
- Customisations and Personalisations

Revised Design Brief

To design a reusable water bottle for young age group of 20 to 30; keeping in mind better handling grip, and aesthetics.

Ideation

Trendhunting

What are Smart Water Bottles.

The health, fitness and wellness industry is booming and technology shows it. There are many new fitness trackers, apps, and other gadgets available for purchase designed to help you better manage your physical and mental health.

It makes sense then that a number of companies are banking on our love for fancy water bottles, our love for tracking our health and fitness, and our love for our smartphones.

Source

What are Smart Water Bottles.

Smart water bottles provide various features.

- Activity Tracking
- Connectivity to smartphone and activity trackers.
- Water Temperature tracking
- Hydration reminders
- Smart Notifications

Source

Lifestyle

Big fashion brands like Burberry, Fendi, and Balenciaga are presenting water bottles as **high-status fashion accessories.**

Source

Source

Source

SPORTS

“People are taking photos of their wellness activities, so of course photos are going to include hydration, and they want it to look cute. A [disposable] water bottle is not cute. So I think that’s a huge influence,”

Taryn Tavella, an associate editor at trend forecasting firm WGSN, tells Refinery29.

Post pandemic rise in health consciousness has also raised demand for sports and fitness related products

Source

Sustainability

Source

Source

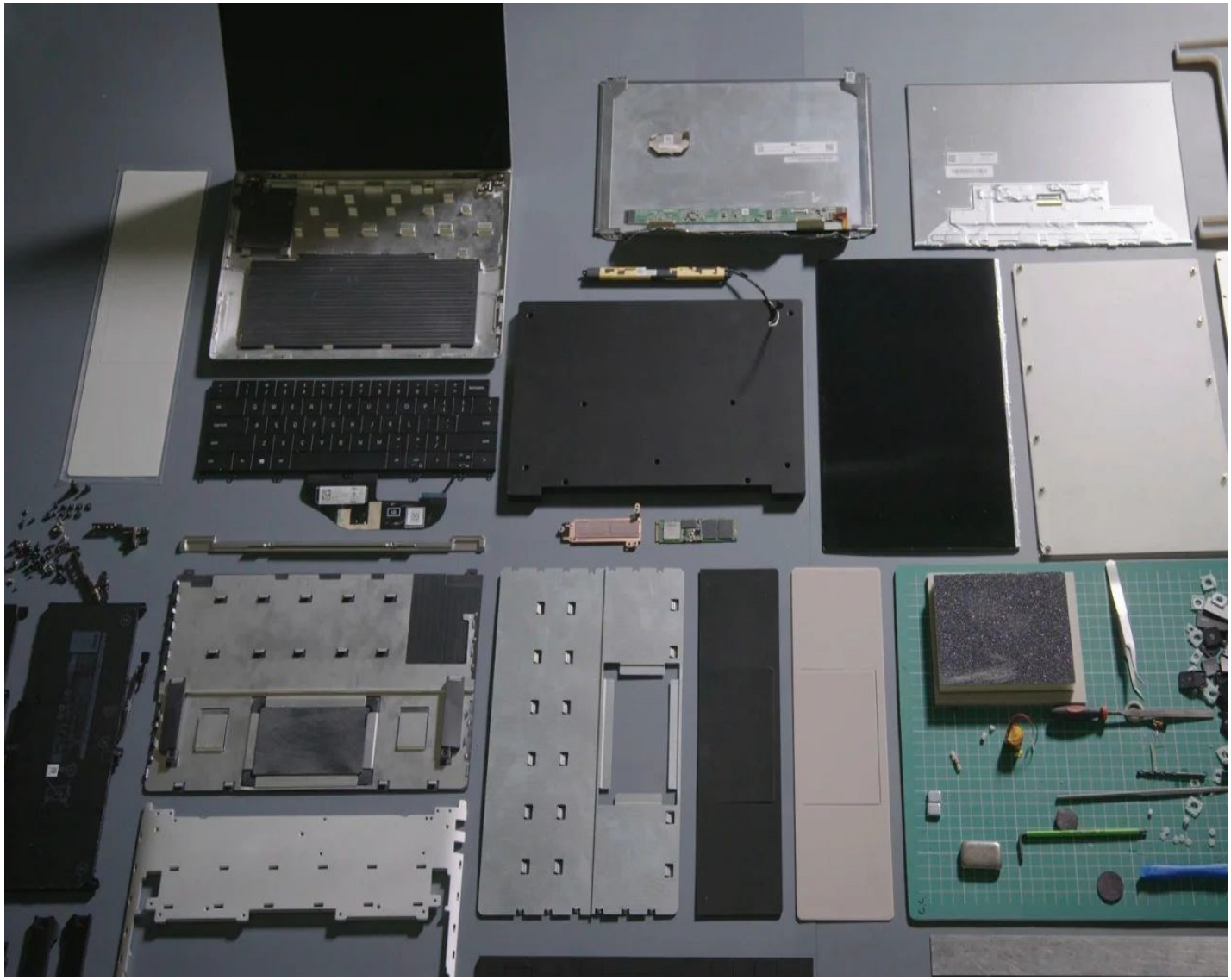
Technology

Source

Technology

Source

Modularity

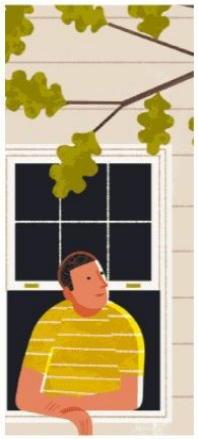


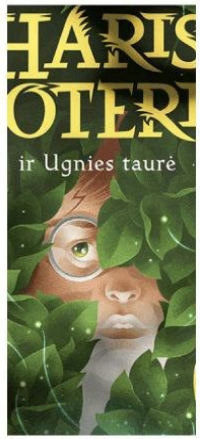
Colour



ROYAL ROOM

Galaxy S21
5G | 128 GB
#TheGalaxyWithYo




NEXT BIG

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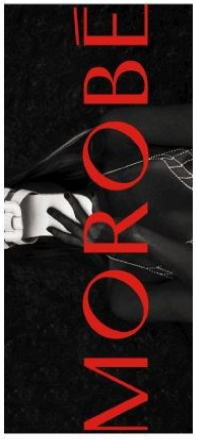
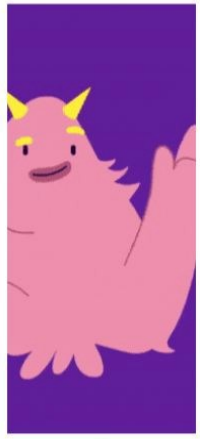

MOROBE

MAG
ikai!!
天狗
TENGU AIRLINES
To outer sky and beyond !
KAPPA'S CABANA
MEKURABE

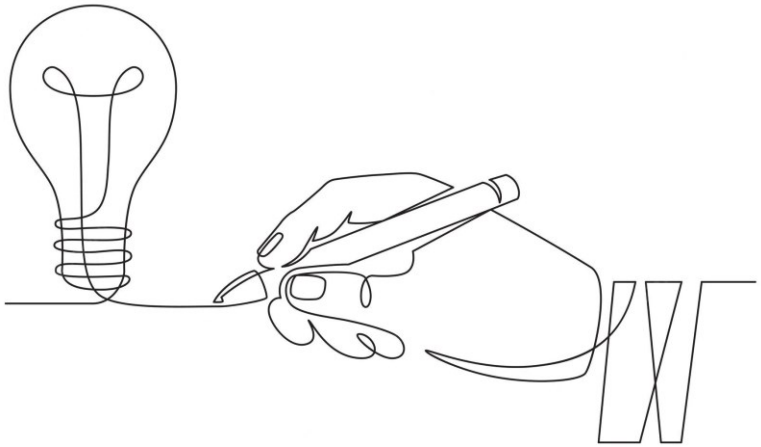

* Hey.





Colour

Concept Generation



Feature Based Ideations

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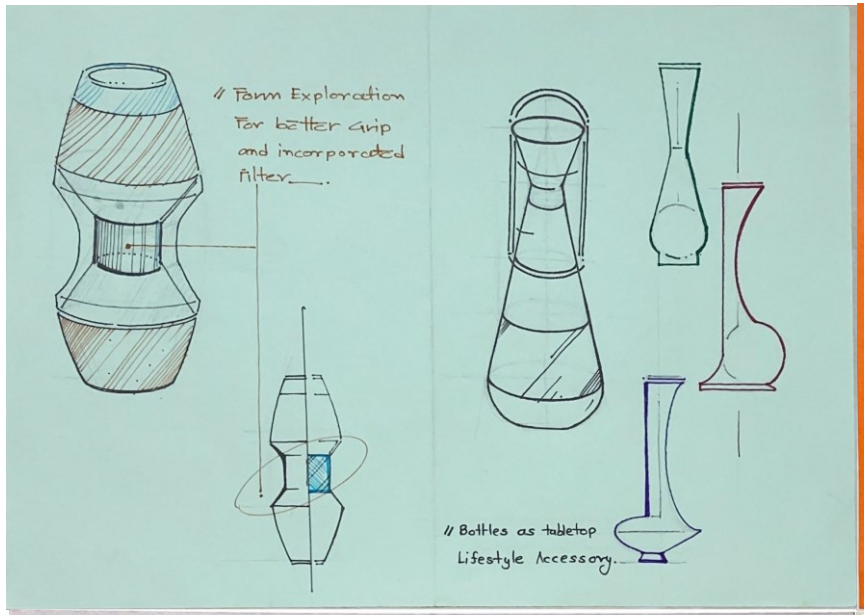

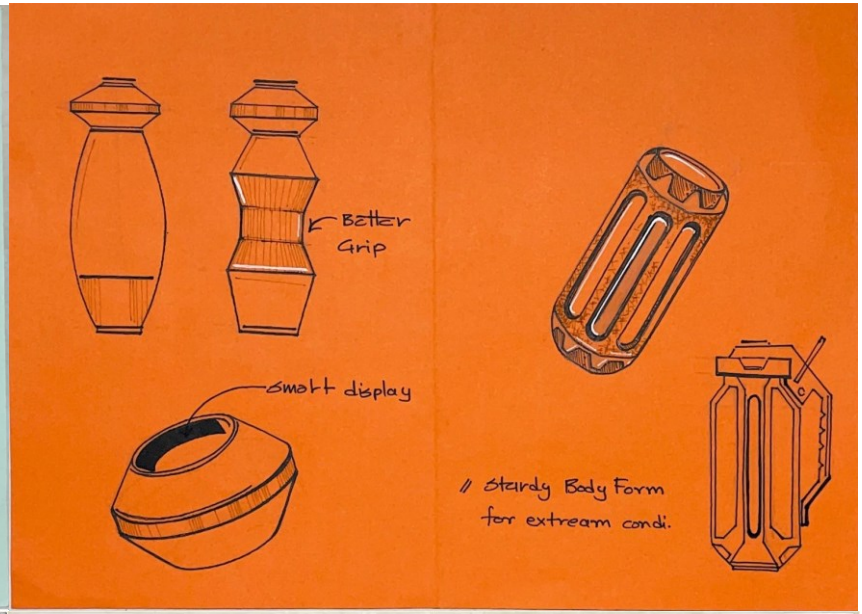

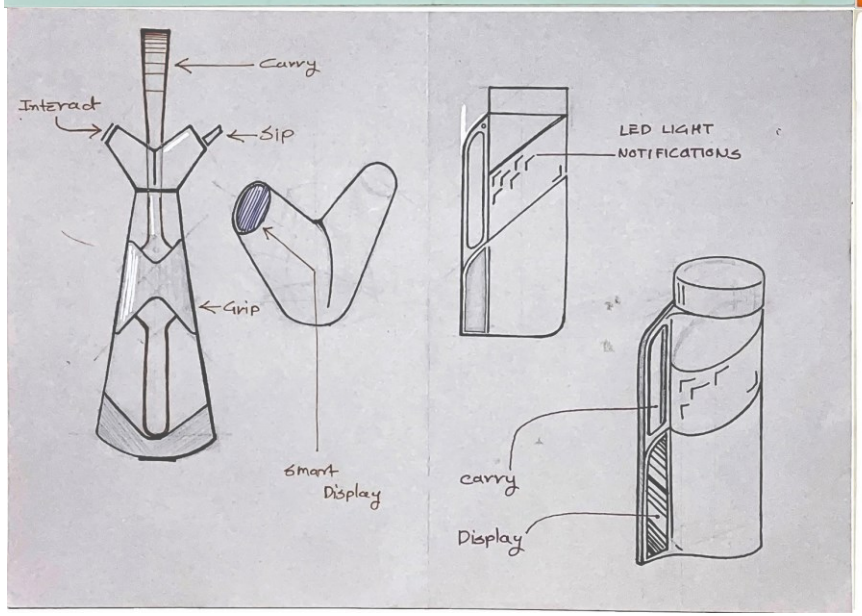

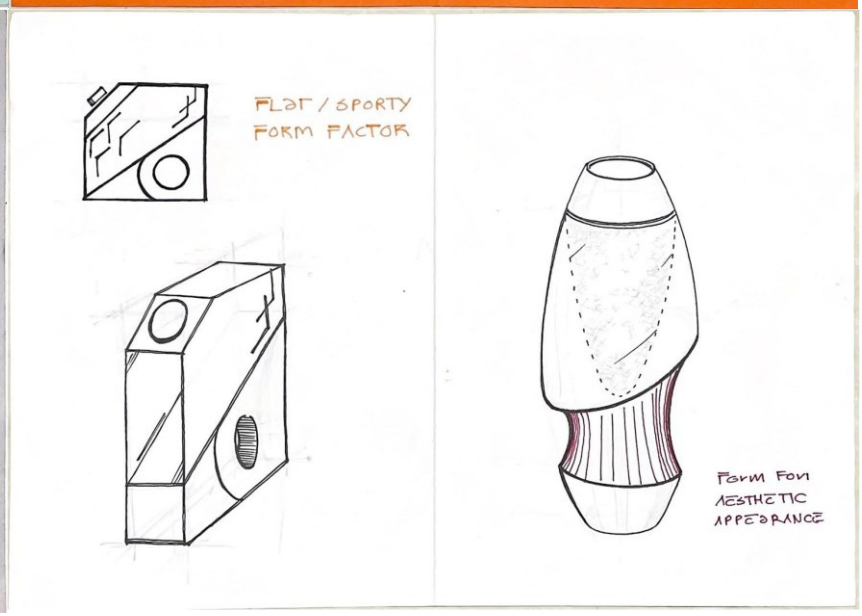

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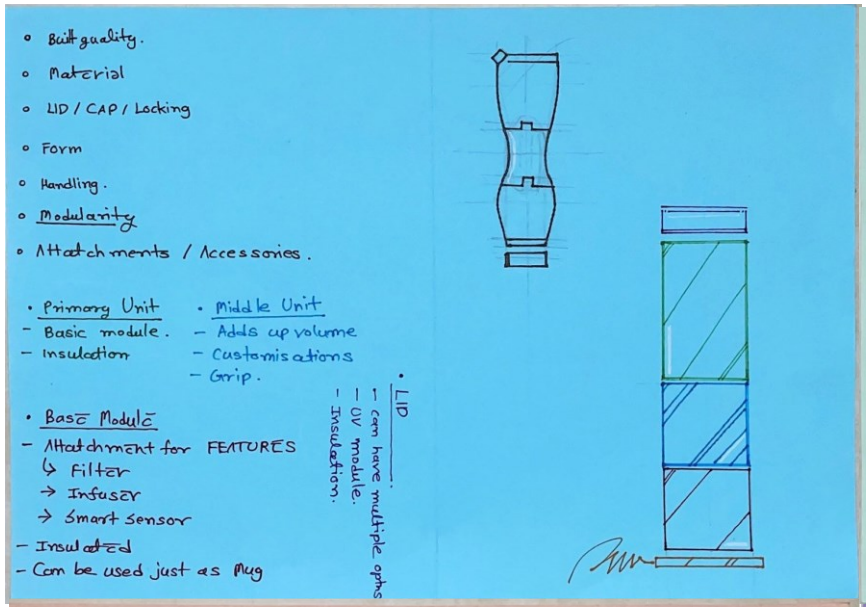

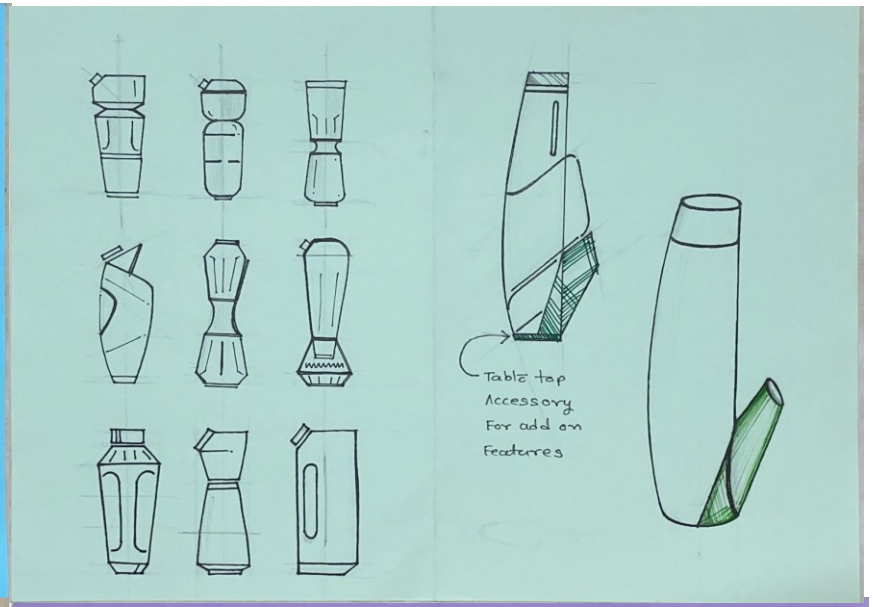

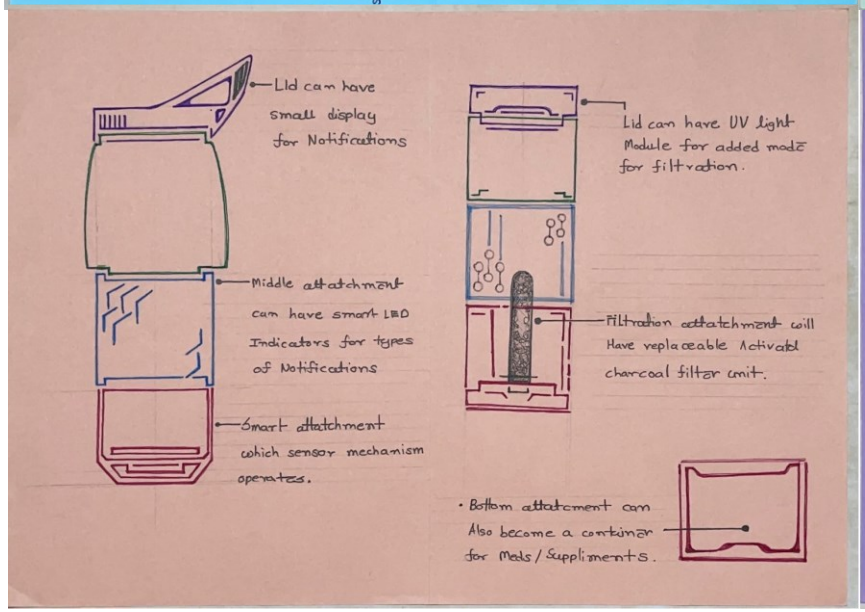

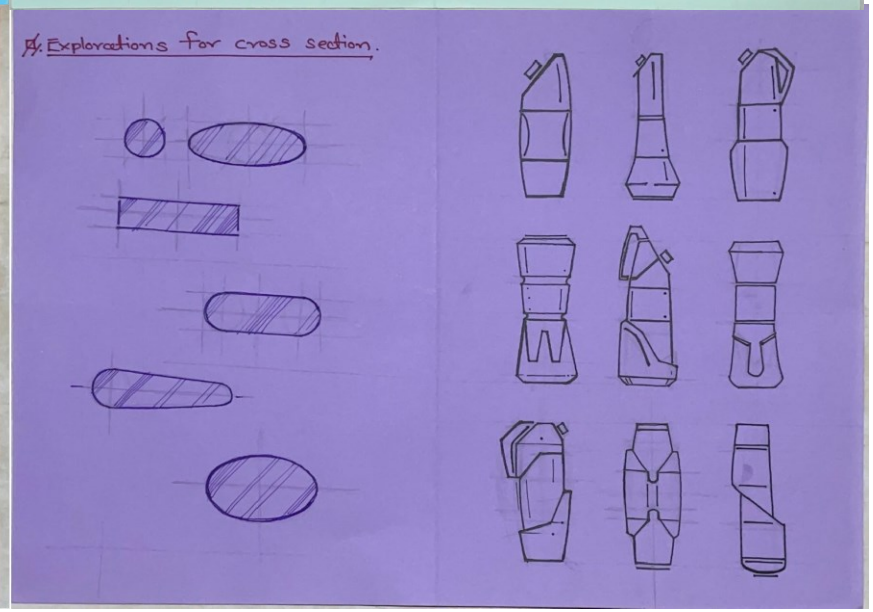

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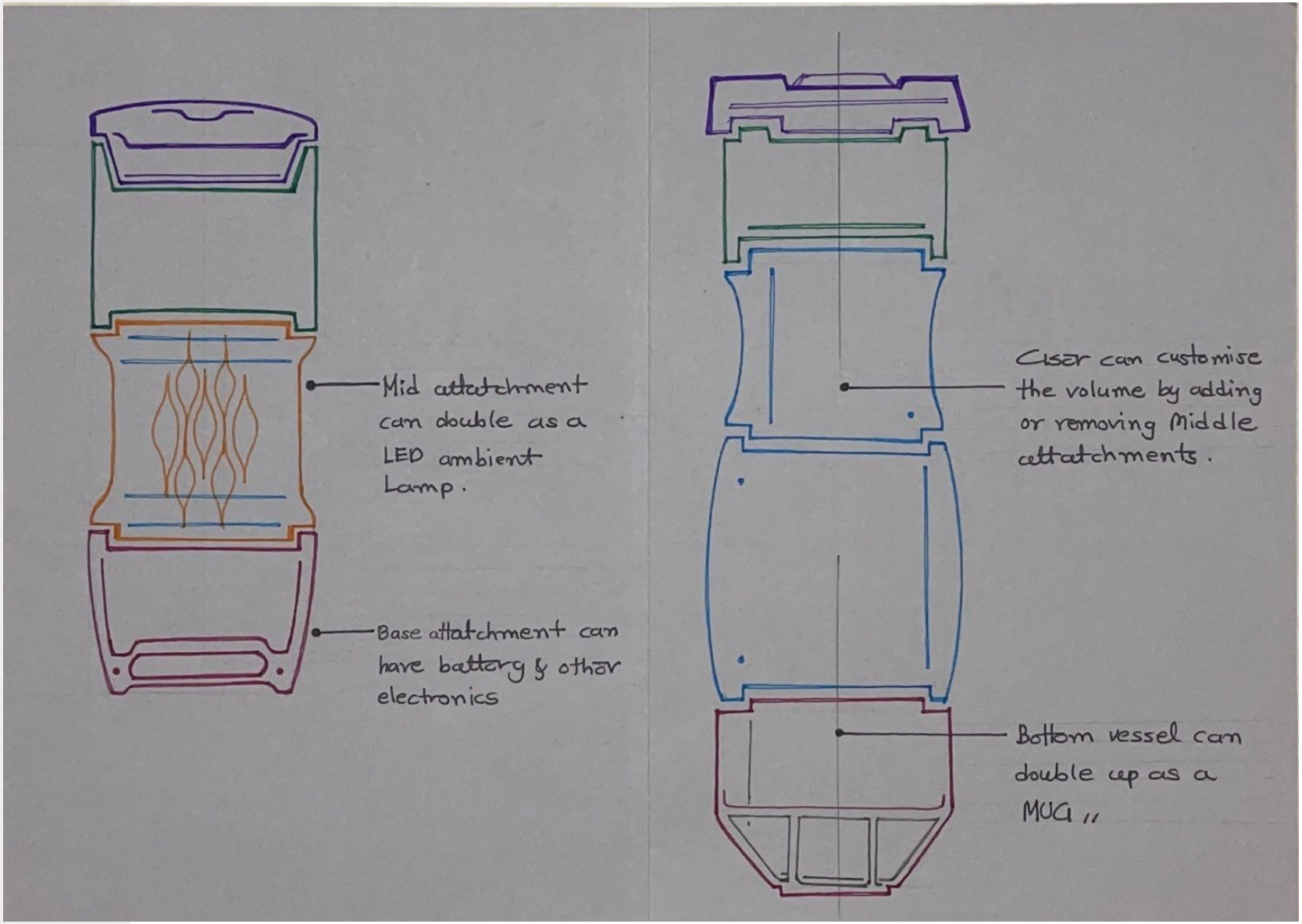
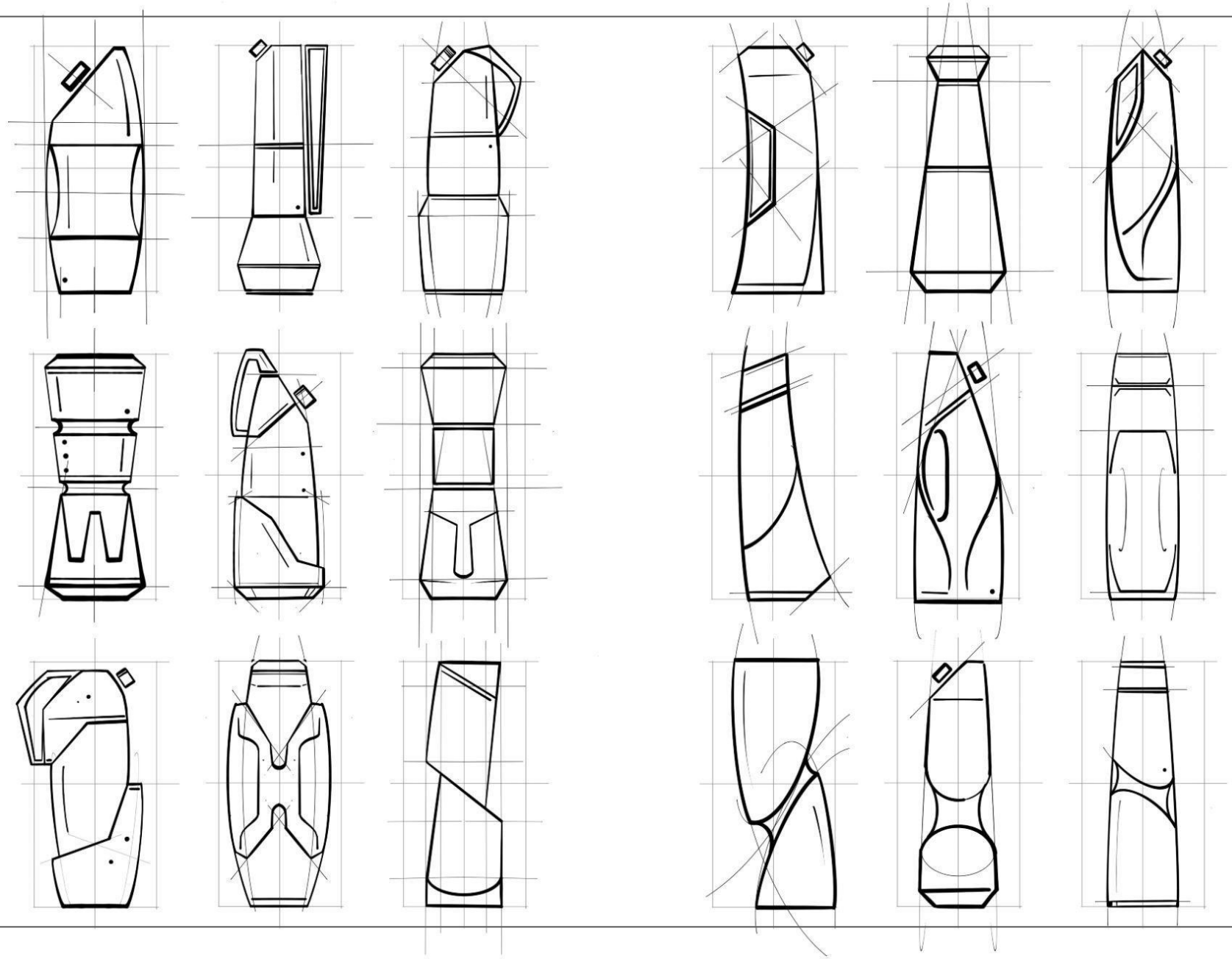
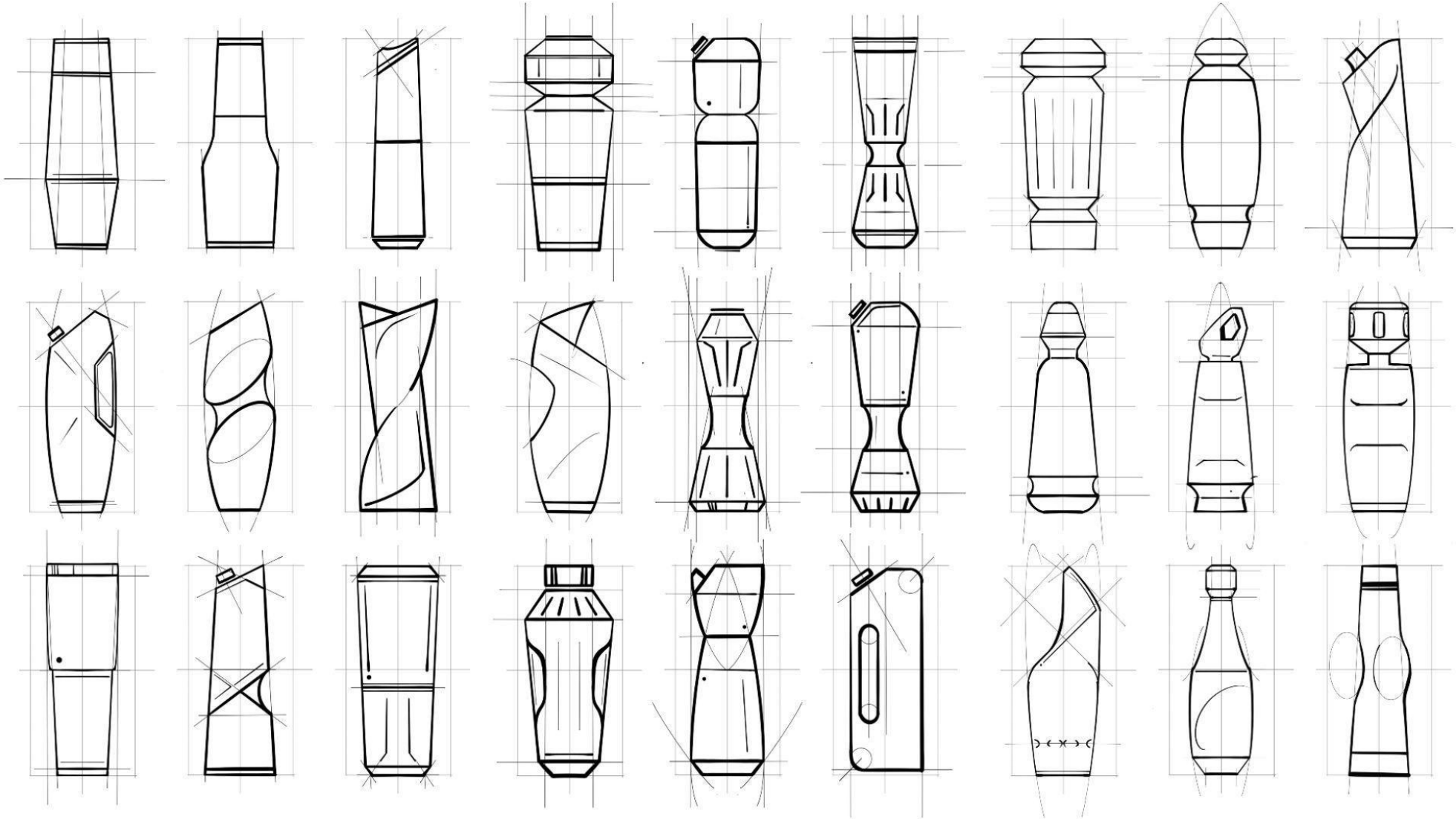
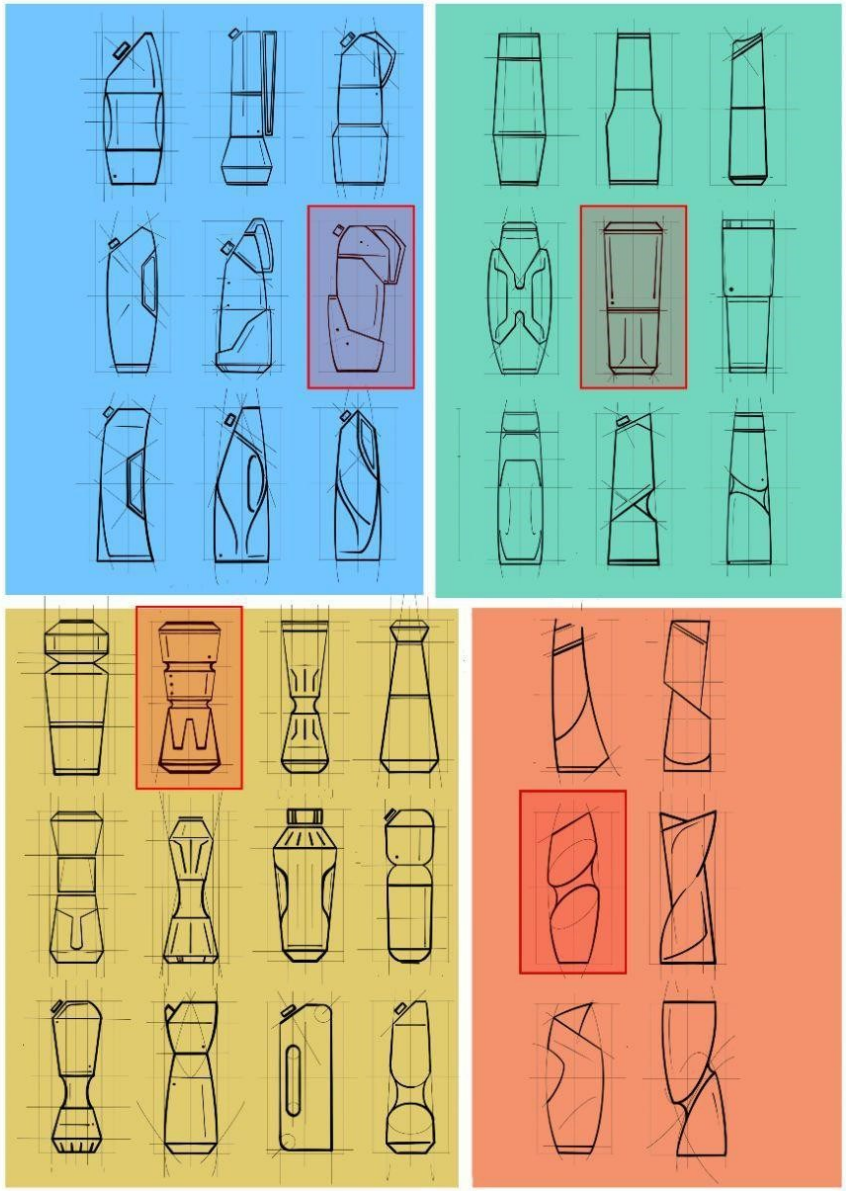
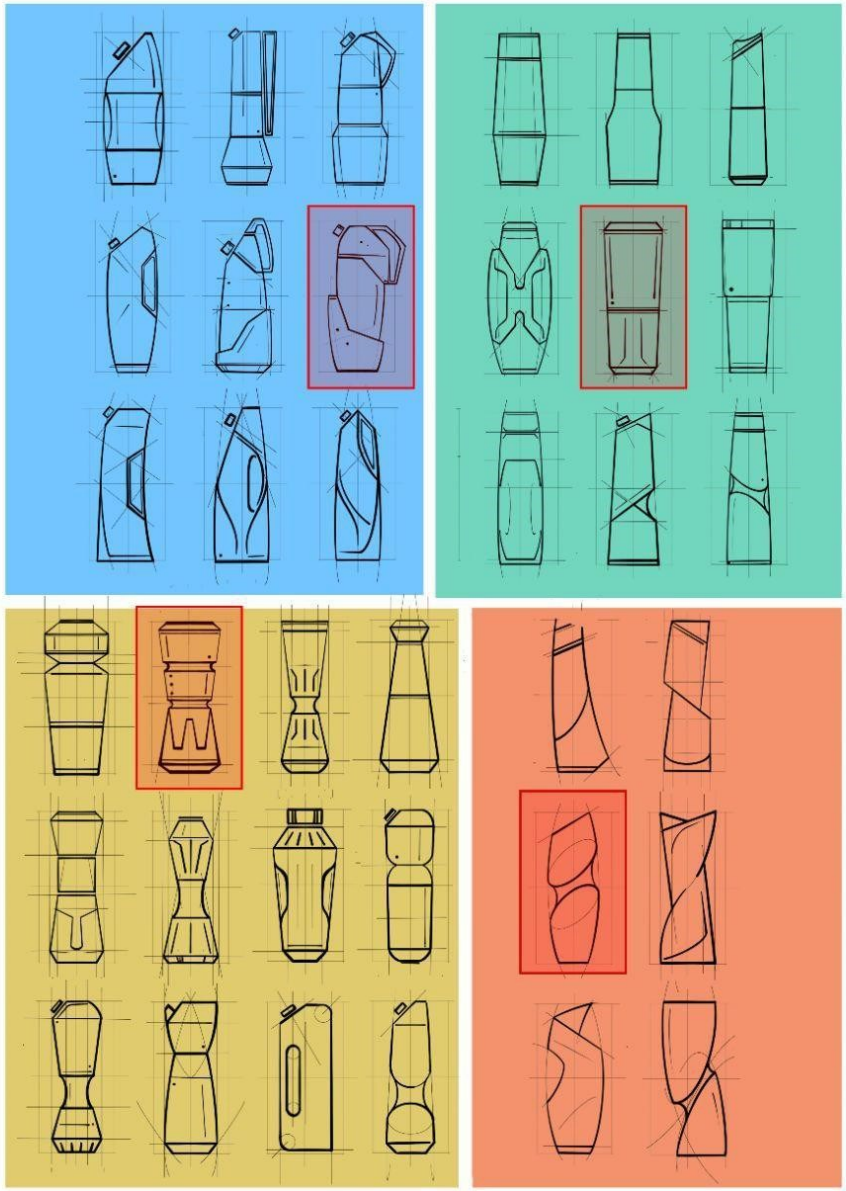


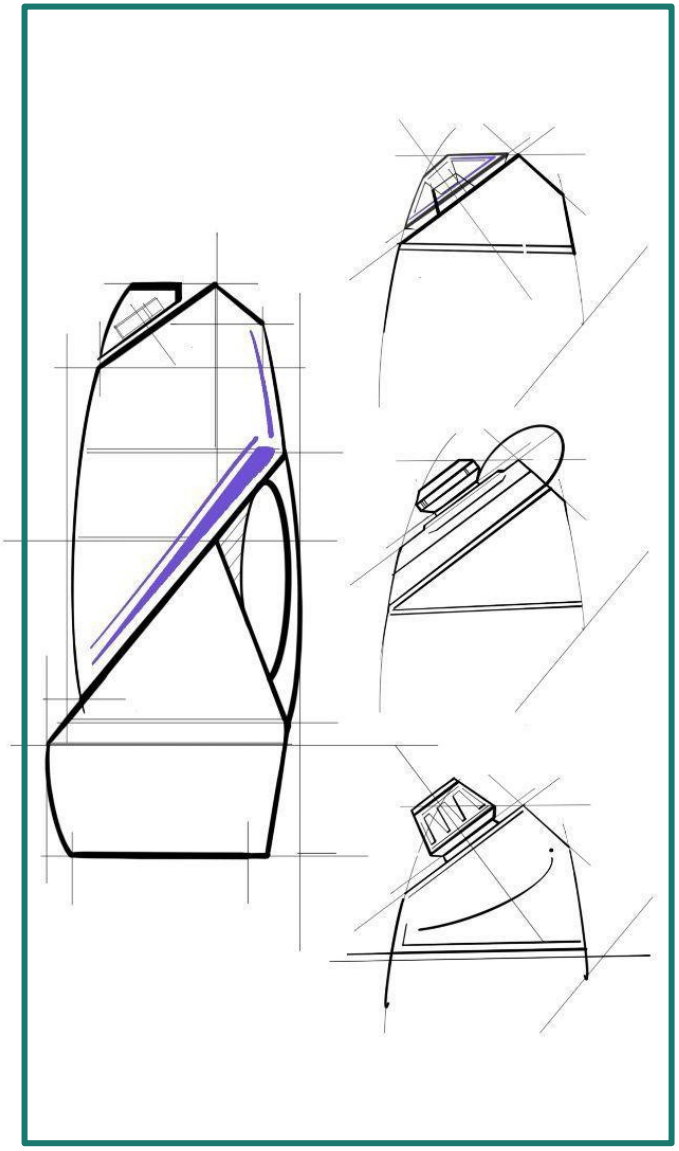
Form Based Ideations

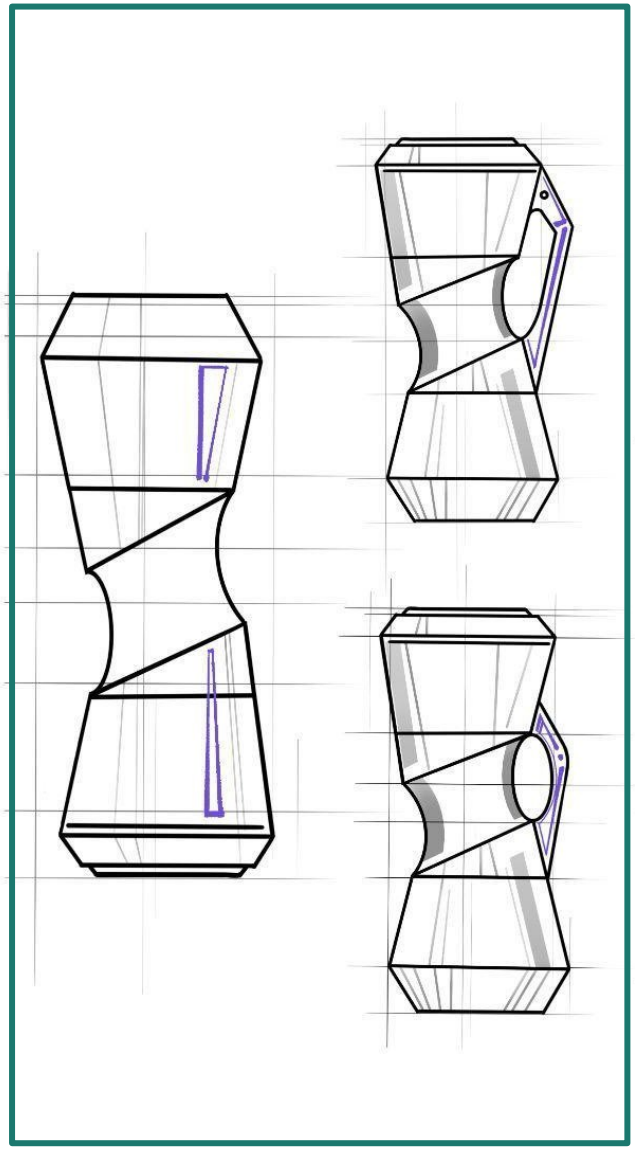


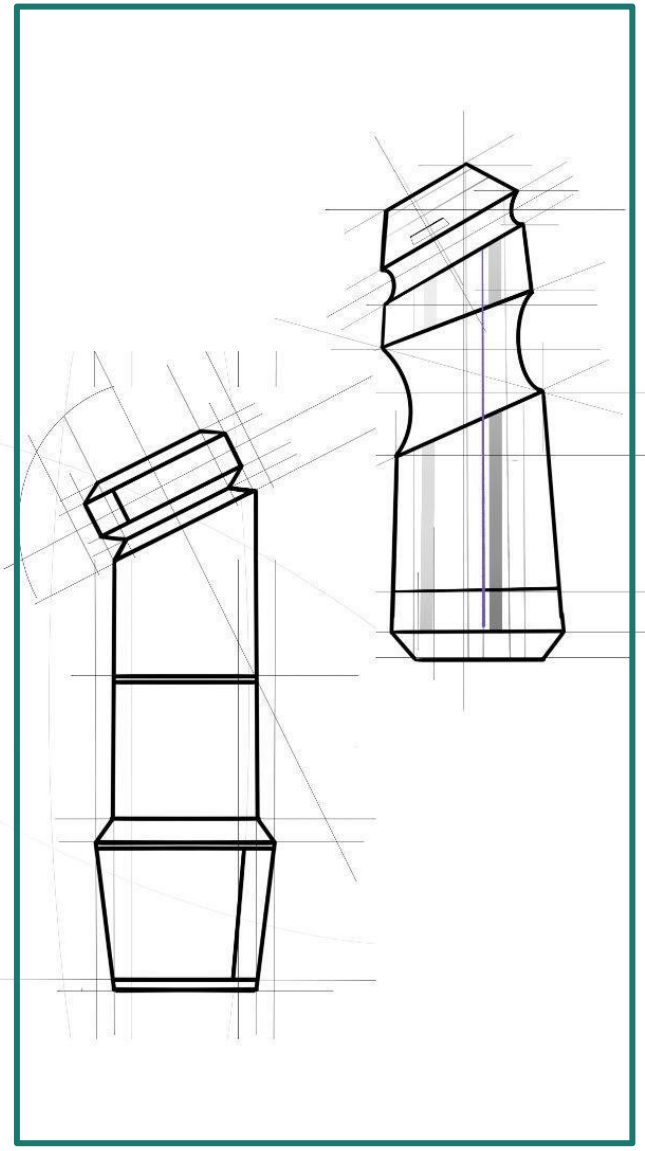
























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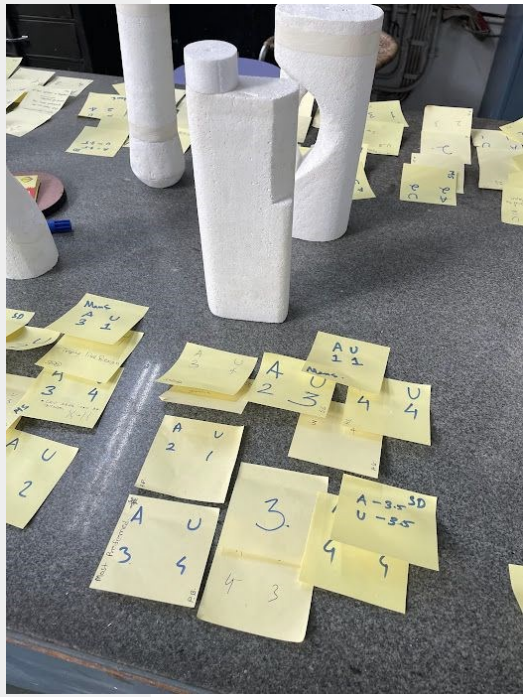


Prototype No.	Aesthetics	Usability	Total
01	28.9	19	47.9
02	18	20.5	38.5
03	37.5	29	66.5
04	30	29	59
05	31.5	32	63.5
06	28	34	62
07	27.5	34.5	62
08	23	25.5	48.5
09	24	30	54
10	23.5	34.5	58
11	36.7	25	61.7
12	32	35.5	67.5
13	26	34	60

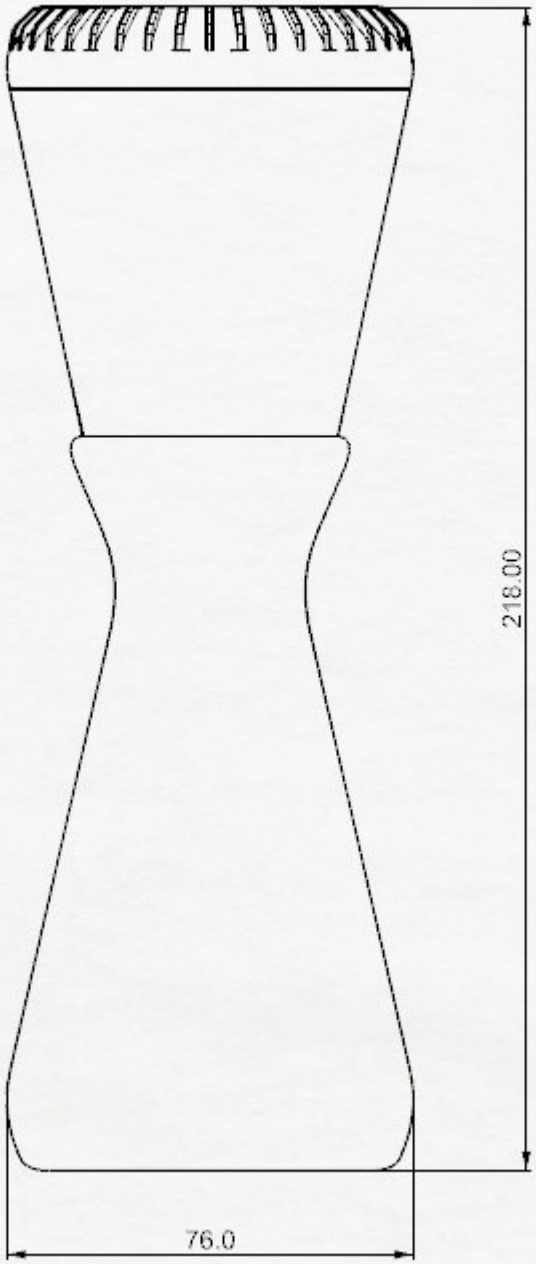
Final Design

Final Concept Based on usability study

- Better grip at the middle part
- Modular iteration can be tried to split the form in 3 parts for customisations and upgrades
- Wide mouth and simple screw fit lid for easy operation can be incorporated.

Proposed Material -
Tritan Copolymer

Proposed Manufacturing Process -
Injection Stretch Blow Moulding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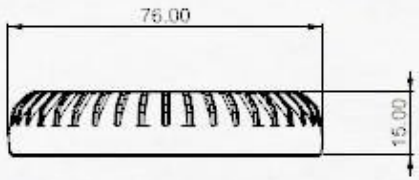
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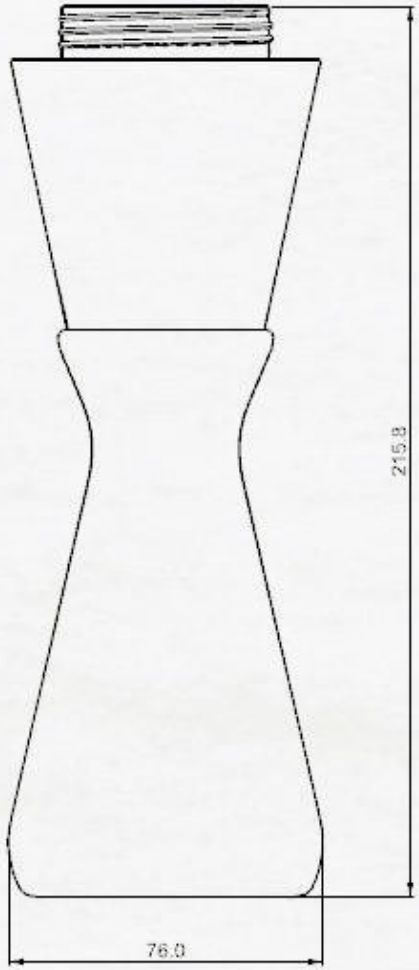
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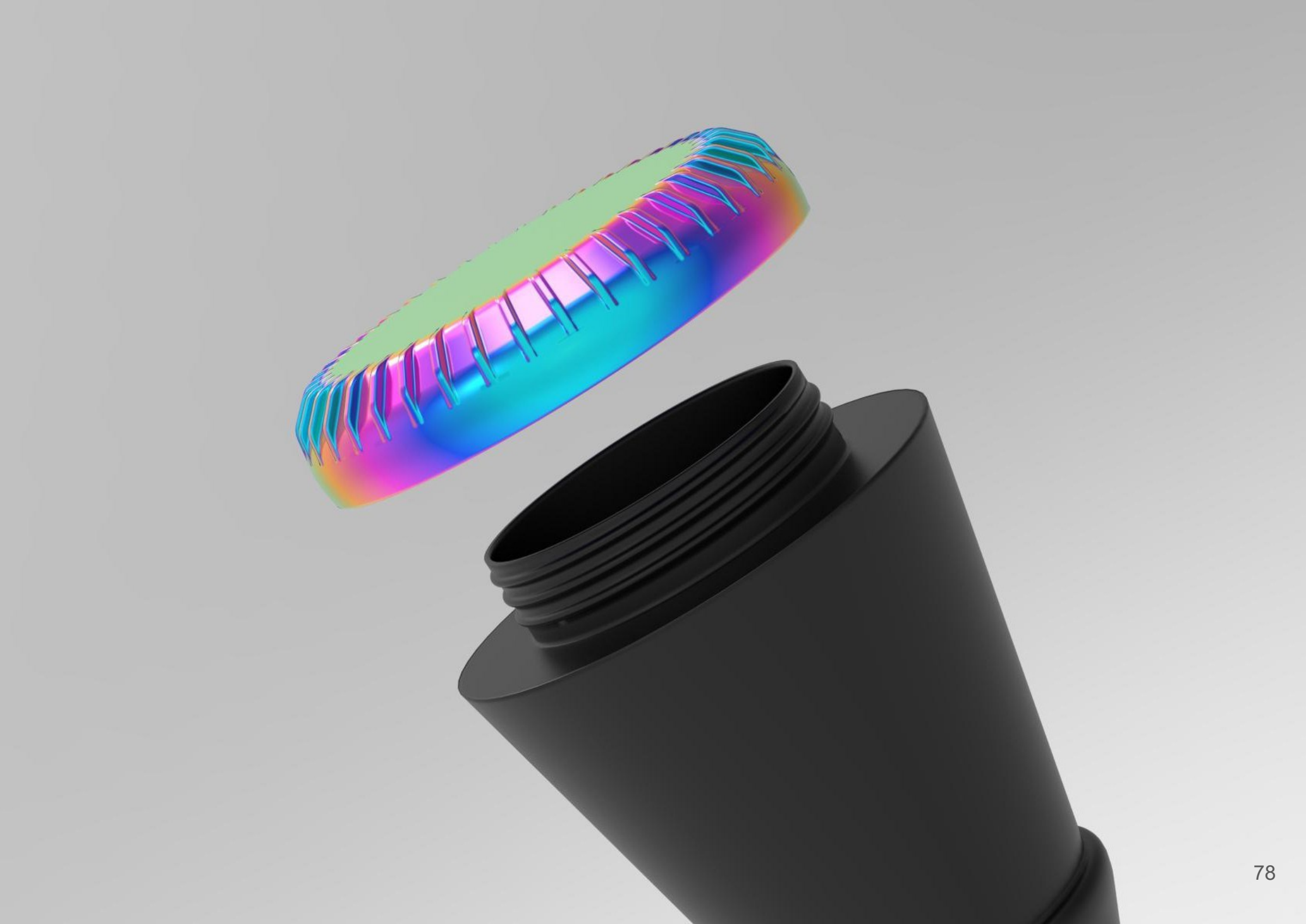

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