Case 8: COVID waste disposal system

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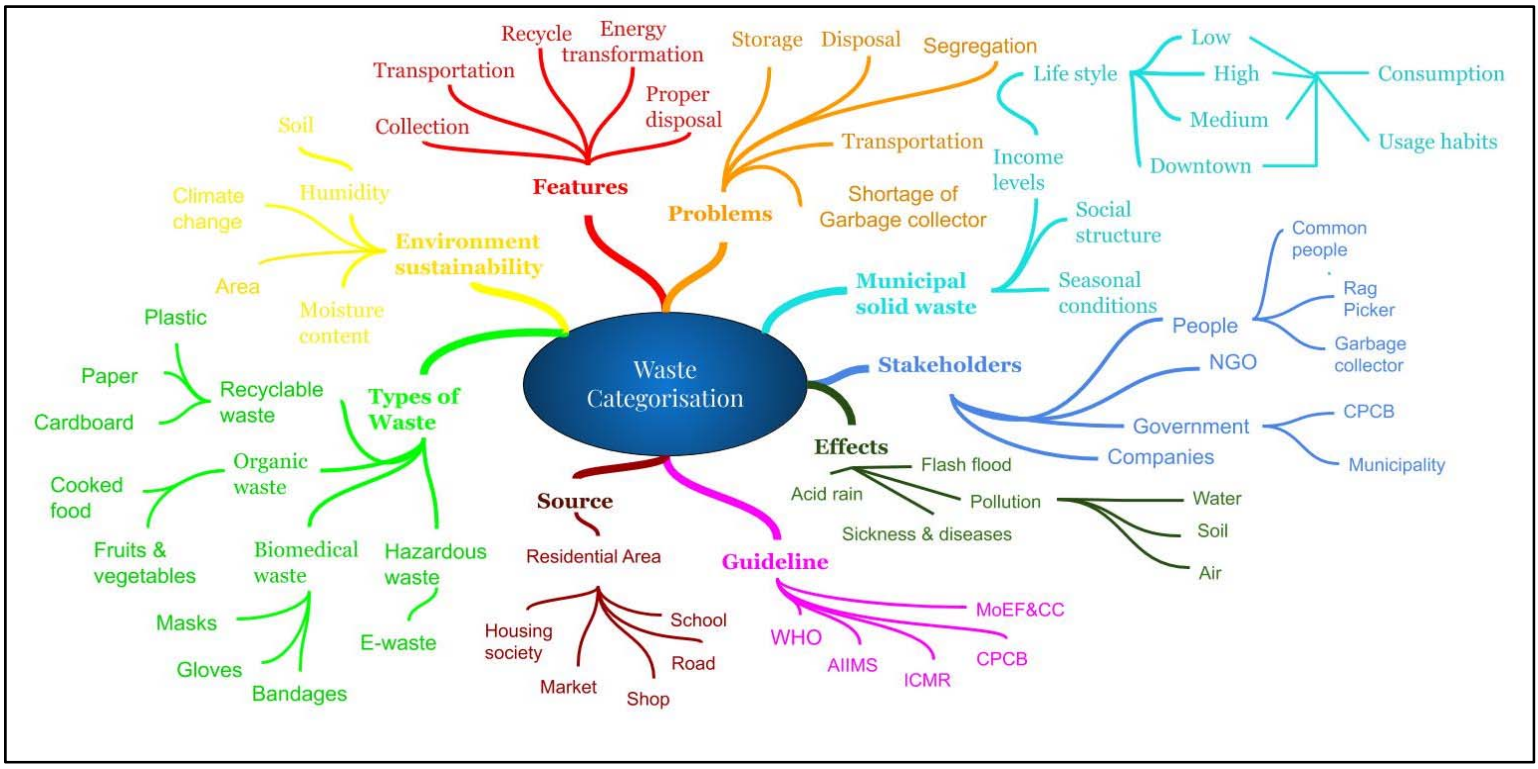
Waste Management has been a global issue, which has yet to be solved. Lot of measures have been taken by various organizations but the rate of waste accumulation is greater than its disposal. Concrete steps have to be taken by individuals also to solve this issue, so as a responsible citizen, we are determined to focus on it. We decided to contribute our time, efforts to understand collection, segregation, recycling and disposal process. To identify problems to work with, we researched for waste categorization.

Mind Map of Waste categorization



In a report by Ranjith Annepu from Columbia university, it shows that household garbage is based on income and season. The following statistics of it.

Sr no	Parameters	1	2	3	4	5	6	7	8	9	10	11	12	13
	The differences in components in the solid waste composition in a region based on income levels and seasonal conditions													
1	**Waste components**	**Organics**	**Paper**	**Cardboard**	**Bulky cardboard**	**Plastics**	**Glass**	**Metals**	**Bulky metals**	**Electrical equipment**	**Hazardous wastes**	**Garden waste**	**Other non-combustible**	**Othe combu tible**
2	**Contents**	Food waste	Newspapers, magazines	Cardboard boxes	-	Plastics except for PET	Jars, colourful and colourless glasses	Iron metals, cans and aluminium materials	-	Phones, radios, pc equipment	Batteries and accumulators, paint boxes	Wood and other garden wastes	Rubber	Combtible materis (diape , shoes bags, textile carpets etc.)
3	**Environmental Impact**	Biodegradable	Biodegradable	Biodegradable	Biodegradable	Non-Biodegradable	Non-Biodegradable	Non-Biodegradable	Non-Biodegradable	Non-Biodegradable	Non-Biodegradable	Biodegradable	Biodegradable	Biodeg adable
4	**moisture content**	62%	5.72%	1.28%	3.14 %	8.75%	4.60%	0.82%		0.43%	0.35%	1.25% %	0.85%	8.34%
5	**Recyclable**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
6	**low Income level (mass on wight basis)**	65.41 %	3.78%	0.94%	2.52 %	7.18%	3.27%	0.44%			0.72%	0.63%		10.45%
7	**Medium Income level (mass on weight basis)**	57.69 %	7.86%	1.59%	3.67 %	11.35%	3.74%	1.06%		0.78%		0.14%	0.35%	0.35%

8	**High Income level (mass on weight basis)**	61.16 %	7.41%	1.35%	3.62 %	7.16%	6.62%	0.51%		0.08%	0.08%	3.96%	2.78%	5.56%
9	**Downtown Income level (mass on weight basis)**	59.13 %	3.95%	1.56%	3.03 %	11.45%	6.90%	2.11%		1.75%	0.46%		0.55%	4.69%
10	**Average of all income levels(mass on weight basis)**	61.64 %	5.72%	1.28%	3.14 %	8.755	4.60%	0.82%		0.43%	0.85%	8.34%	1.09%	
11	**Toxicity**	NO	NO	NO	NO	NO	NO	NO	NO	NO	Yes	NO	NO	NO
12	**Source**	Farms	Mills	Factories	Factories	Factories	Factories	Factories	Factories	Factories	Factories	Factories	Rubber Mills	Factors

From the report of Ranjith Annepu we understand the category of different waste. The factor that effect the generation of waste is temperature, climate, season, income and population of people.

Our Review

In COVID -19 Pandemic Situation, COVID waste disposal process is followed systematically and carefully as per guidelines given by Doctors and trained health workers. Guidelines are also released for Housing Societies, Group Homes for Individuals with Disabilities, Communities, Workplaces but the situation differs with these common people due to lack of awareness and lack of availability of training and guidance. This leads to an unsystematic process for disposal of used masks, gloves and other hazardous waste during this pandemic situation. This waste is thrown into dustbins, streets and at many other places. It has become a challenge for garbage pickers, collectors and segregators. Very few safety tools are designed and developed for these people, it also creates stress and health issues among these people. This mixed waste was also a challenge before but it has become a big challenge now during this pandemic situation. Innovators like us must think for such a system which will collect, segregate and also dispose COVID waste material, such as used masks, gloves, Tissue etc. from various residential sources like housing societies, markets and other public & private places. This will help humans and the environment too.

We decided to research and develop Mechanism for collection and disposal of masks and medical waste generated in residential areas.

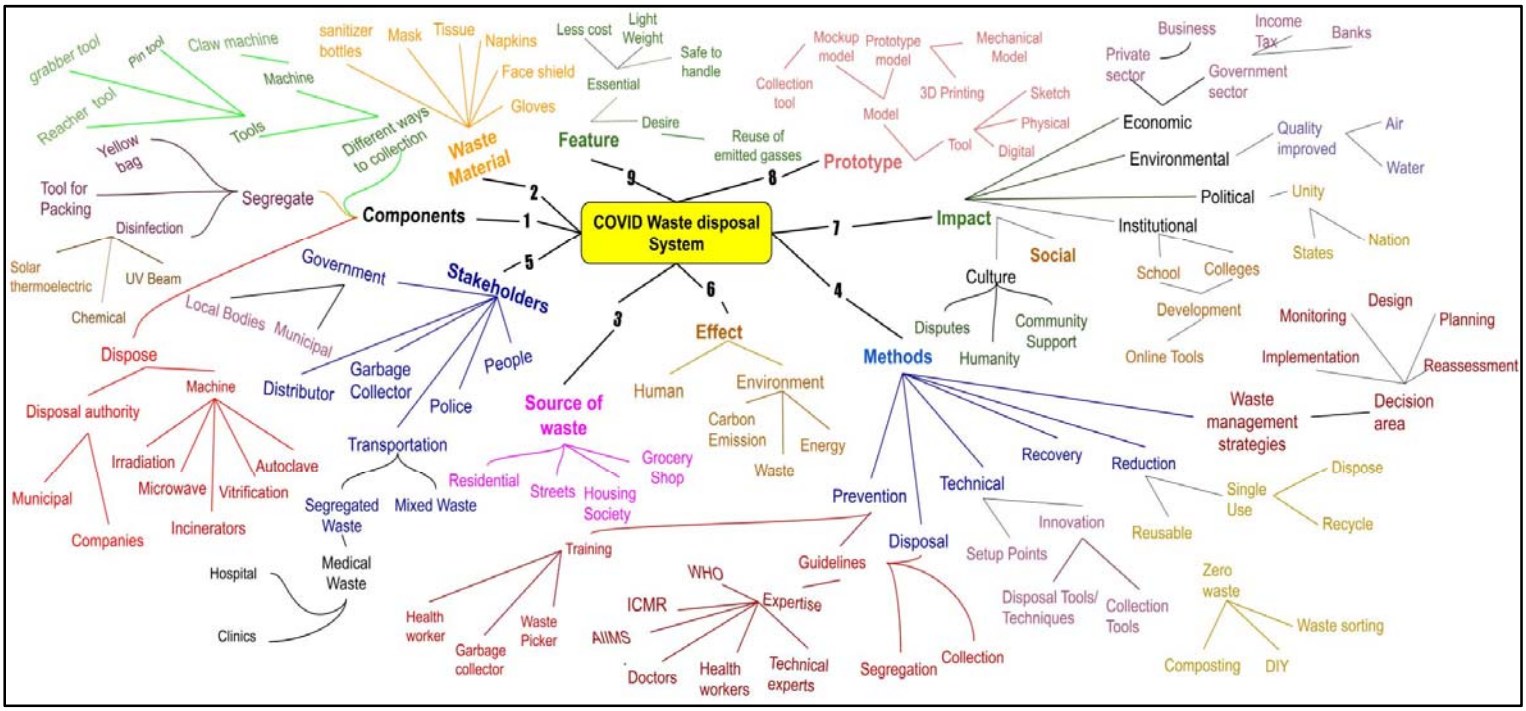
Problem Statement :

COVID Waste Disposal System for Residential area

Key insights

- Waste management in epidemic outbreak
- Health and environmental considerations
- Quantity of wastes for treatment and disposal
- Health and safety considerations for garbage pickers
- Operation and maintenance considerations
- Training requirements for operation of the method
- Space availability and Public acceptability

Mind map



Communication with Stakeholders to understand policies and work for Residential Areas

1. **Communication with garbage collector**

We conducted a survey at residential areas to understand problems faced by garbage collectors. Along with we also tried to communicate with them in person and also tried to reach through telephonic conversation

a. **Details of in person and telephonic conversation**

Sr.	Stakeholder	Num	Area (Locality)	Mode of Communica	Review of	Feedback

No.	s	ber		tion	Discussion	
1	Garbage Collectors	5	Thane, Kalwa, Arnala, Badlapur	Telephone	Training and Guidelines are not shared how to handle waste At few places mask gloves are not provided	These collectors are surviving on self-care. They are aware about the situation but stressed due to lack of training

b. Summary of survey done in residential area with garbage collectors

We tried to reach garbage collectors through google survey form. We received very few responses as at many places in the country specially in metro cities door to door garbage collection is not happening these days. Summary of actual scenario around the nation.

Sr. No.	Conversation with garbage collectors	Feedback
1	States	Maharashtra, Gujarat, Telangana, Uttarakhand
2	Tools used for collection	• Trucks and bins • GHMC vehicle • Gloves • Two plate like thing they use to grab and put it in the garbage bin
3	Masks gloves found on road or in dustbin with household waste	Average 50 - 100 masks and gloves found daily in all surveyed residential area
4	Challenges faced while collecting waste during pandemic situation	• Need more manpower • They are in risk with their health • Do not collect waste from door to door

5	Provision of Disposal system	No disposal facility available. all waste collection into collection box which goes to landfill

2. Communication with NGO

We make an effort to reach and communicate with people, organizations and those who are dealing with waste management challenges and contributing in awareness, finding solutions for social and environmental change. We spoke with a few of them on various online platforms to understand challenges and current situations in a better way.

Sr. No.	NGO	Website	Area (Locality)	Mode of Communication	Review of Discussion	Feedback
1	Srhikant parab	http://www.shrikantparab.com/	Mumbai	Zoom	Talked about Guidelines and policies	Segregation of mask and gloves at separate bag in residential area
	Director of Asia Affairs, DELTTA GROUP HOLDINGS INC. – USA				Discussion with Municipal Corporation is in process for residential area (mask and gloves) waste	He suggested to aware people for this segregation and separate collection of this material .
						Avoid throwing in regular dustbin with other waste
2	Member of Child help foundation	https://www.childhelpfoundation.in/	Mumbai	Telephonic Talk	Collection and disposal of Waste on Landfill	No Facility available for segregate these masks and gloves also other non-disposal material

3	Member of United way mumbai	https://www.unitedwaymumbai.org/	Mumbai		Rag Pickers and Waste collectors are working but not separating mask and gloves which comes from mix waste from residential area	
4	Kaustubh Tamhankar founder of Zero-Garbage System	http://zerogarbage.co.in	Mumbai	Webinar on Meet to Go	Waste categorization how to care our own waste at source	Mechanism to be developed for collection and disposal tool at residential area

By conversation with these organizations , we came to know the importance of creating awareness and how essentially training is required to cleanliness warriors. Along with this we understand the necessity of collection and disposal mechanisms for residential areas.

3. Communication with Grassroot innovator

We spoke with a few innovators and shared and discussed our idea with them. We received diverse inputs from each one of them which helped us to brainstorm, reshape and redesign our sketches and mock up models.

Sr. No.	Name Of the Innovator	Location	Mode of Communication	Review of Discussion	Feedback
1	Upendrabhai Chital	Gurjarat	Telephonic Talk	Review on model made by him Review on mock up model	Essential things to keep in mind while making a model.

2	Shyam bedekar	Gujarat	Telephonic Talk	About their incinerator and suggestions for us	their machine used to half burn so that the toxic gases won't emit only a little smoke, clay was used, safe to keep in the bathroom or on the terrace. suggestions like to build off some other material.
3	Vedika Kulkarni	Mumbai	Telephonic Talk	Review on emission of gases while burning, temperature of incinerators, the solutions on it.	Chemical emission can be tested by a topography machine, thermal technique can be helpful for disinfecting and then mixing again with other waste, can use certain techniques to convert emission in other gases.

4. Communication with medical store

To know about masks and gloves which are currently available in the market. We spoke with various medical stores. Through our interaction we come to know about the availability of masks and gloves with its type.

Sr. No.	Name of the Store	Location	Mode of Communication	Review of discussion	Feedback
1	Health care	Andheri	Telephonic Talk	about available masks and gloves	3 Triple ply, 2 N95, Normal masks , no gloves
2	Ambaji medical	Mumbra	Telephonic Talk	about available masks and gloves	3 triple ply, cotton,N95, black masks, 2 were washable & other 2 one-time use. Latex gloves one-time use
3	Kambaa medical	Nalasopara	Telephonic Talk	about available masks and gloves	Only surgical, N95 mask of 1-time use
4	Deepak medical	Goregaon	Telephonic Talk	about available masks and gloves	N95 & cotton masks were available which were disposable after 1-month , latex gloves for 1-time use

5	Bombay medical	Bandra	Telephonic Talk	about available masks and gloves	Surgical mask one-time use mask and green color washable mask & in gloves nitrile gloves are better in material than latex

5. Summary of survey done in residential area

Communication with common people

Residential people are waste creators so it becomes essential to understand their habits, actions and reactions. To know this, we conducted a survey through social media (WhatsApp) and circulated google form among our friends, family members and also in various groups. More than 100 people responded. We tried to analyze the pattern to understand the actual problem , challenges and necessity of the collection and disposal mechanism.

Total people have taken part in survey

Sr no	People	Number	Percentage
1	Taken survey	128	100 %

Statistics of people used things during Covid outbreak

Sr no	People	Number	Percentage
1	Use mask	94	92.2 %
2	Use handkerchief	40	38.8 %
3	Use scarf	48	46.6 %
4	Use towel	14	13.6 %
5	Use face shield	26	25.2 %
6	Use gloves	48	46.6 %
7	Use hand sanitizer	6	6 %
8	Use washable mask	87	84.5 %
9	Use one-time use mask	16	15.5 %

Things people thrown

Sr no	People	Number	Percentage
1	Thrown mask in dustbin	38	36.9 %
2	Thrown mask in landfill	4	3.9 %
3	Thrown mask in road	2	1.9 %
5	Throw diaper in dustbin	21	20.40%
6	Throw Sanitary Napkin in dustbin	70	68 %
7	Thrown Bandages in dustbin	44	42.7 %
8	Thrown gloves in dustbin	29	28.2 %
9	Do not thrown mask yet	59	57.3 %

Segregation of waste done by people

Sr no	People	Number	Percentage
1	Segregate medical waste	22	21.4 %
2	Segregate organic waste	47	45.6 %
3	Segregate recycling waste	65	63.1 %

Sr no	People	Number	Percentage
1	Think waste management is important	99	96.1 %

6. Communication with Gian coordinator

Support is a key. Innovation needs support , co-coordination and guidance. GIAN Coordinators resolved our difficulties and showed us the path during the entire process.

Sr. No.	Name of the Coordinator	Place	Mode of Communication	Review of Discussion	Feedback
1	Alzubair Sayed	Gujarat	Telephonic Talk	Work on Collection tool is essential Review on mock up model	Ergonomic design considerations are essential for final mock up model
2	Chetan Patel	Gujarat	Session	Contact with grassroot innovator	Mechanism detail
3	Rushi Khambholia	Gujrat	Session	Contact with grassroot innovator	Mechanism detail

Prior Art Work

1. **Literature Review**

a. Reverse Logistics Network Design for Effective Management of Medical Waste in Epidemic Outbreaks: Insights from the Coronavirus Disease 2019 (COVID-19) Outbreak in Wuhan (China)

The outbreak of an epidemic disease may pose significant threats to human beings and may further lead to a global crisis. In order to control the spread of an epidemic, the effective management of rapidly increased medical waste through establishing a temporary reverse logistics system is of vital importance. However, no research has been conducted with the focus on the design of an epidemic reverse logistics network for dealing with medical waste during epidemic outbreaks, which, if improperly treated, may accelerate disease spread and pose a significant risk for both medical staff and patients.

Increased medical Facilities:

For *reverse logistics network design* in epidemic outbreaks, which aims at determining the best locations of temporary facilities and the transportation strategies for effective management of the exponentially increased medical waste within a very short period.

Lockdown:

In order to control the rapid spread of the COVID-19, the epidemic center, Wuhan, a city with more than 10 million residents, was placed on effective lockdown on January 23th and the lockdown measures were shortly after implemented in the whole of Hubei Province and electronic surveillance measures imposed by an authoritarian government would work in other countries. The implementation of lockdown policies has

effectively restricted both inbound and outbound transportation in Hubei Province, and the mobility of people within the cities has been largely reduced.

In Wuhan, within two weeks, several temporary hospitals have been established to provide more clinical beds and medical service for the COVID-19 infection. This has led to significant logistics challenges in both forward and reverse directions.

Medical waste Management :

From the reverse logistics perspective, the rapidly increased amount of medical waste due to the COVID-19 outbreak needs to be collected and treated in a timely, safe and effective manner in order to minimize the virus spread and the risk to humans. Taking into account the real-world challenge faced in Wuhan, a novel multi-objective multi-period mixed integer linear program is modeled for the reverse logistics network design of medical waste management in epidemic outbreak, which aims at improving the decision-makings related to the temporary facilities and the transportation planning.

Reference :

https://www.mdpi.com/1660-4601/17/5/1770/htm#app1-ijerph-17-0177

b. Disinfection technology of hospital wastes and wastewater: Suggestions for disinfection strategy during coronavirus Disease 2019 (COVID-19) pandemic in China

- O_3, UV, chlorine disinfectants are used for hospital wastewater disinfection.
- Incineration, chemical and physical techniques are used to disinfect hospital wastes.
- Providing suggestions for hospital wastes and wastewater disinfection during COVID-19.
- The chlorine disinfection and incineration are primarily recommended.

China has established and strengthened the managing team of epidemic prevention and control in each ward. In order to train medical staff in an effective way, the ward establishes related knowledge and basic methods in prevention and control of Covid-19.

Each staff needs to comply with strict hand hygiene to improve disinfection prevention. The ward is sterilized and ventilated with the circulating air sterilizer 3 times a day, more than 30 minutes for each time.

Disinfection of public air should be done without people on sight, acid peroxide and hydrogen peroxide will be used for ultra-low capacity spray disinfection, and the disinfection frequency was also 3 times a day.

Reference :

https://www.sciencedirect.com/science/article/pii/S0269749120310435

https://www.sciencedirect.com/science/article/pii/S0305417920302370

c. Safety and human health

1. Points to be consider from WHO Guidelines

Recent evidence indicates that COVID-19 virus (SARS-CoV-2) survival on surfaces is similar to that of SARS-CoV-1, the virus that causes severe acute respiratory syndrome (SARS),with survival on surfaces ranging from 2 hours to 9 days. The survival time depends on several factors, including the type of surface,

temperature, relative humidity and the strain of the virus. The same study also found that effective inactivation could be achieved within 1 minute using common disinfectants, such as 70% ethanol or 0.1% sodium hypochlorite

Reference:

https://www.who.int/publications/i/item/water-sanitation-hygiene-and-waste-management-for-the-covid-19-virus-interim-guidance

2. Guideline is under the duties of the State Pollution Control Board

has advised non-quarantined homes and residents to dispose of used masks by disinfecting them with ordinary bleach solution (five per cent) or sodium hypo-chlorite solution (one percent). Further, wrap and keep in a closed bin before handing the mask over to the sanitary worker. This waste must be treated as domestic hazardous waste and should be incinerated

Reference:

http://mpcb.gov.in/

d. There are two distinct types of waste disposal to land—open dumps and sanitary landfills.

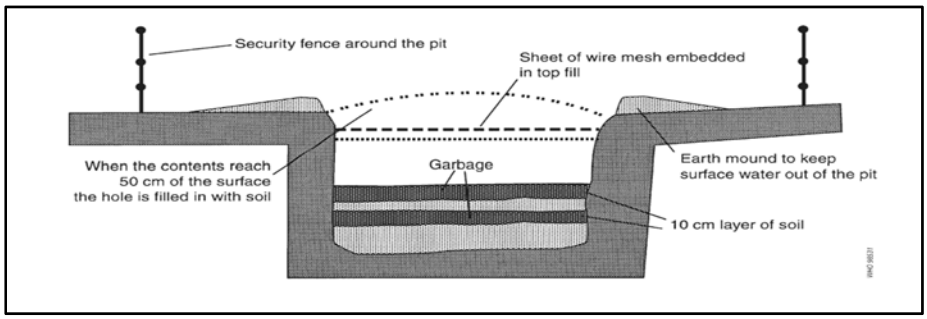
a. Open dumps

These are characterized by the uncontrolled and scattered deposit of wastes at a site; this leads to acute pollution problems, fires, higher risks of disease transmission, and open access to scavengers and animals. Health-care waste should not be deposited on or around open dumps. The risk of either people or animals coming into contact with infectious pathogens is obvious, with the further risk of subsequent disease transmission, either directly through wounds, inhalation, or ingestion, or indirectly through the food chain or a pathogenic host species.

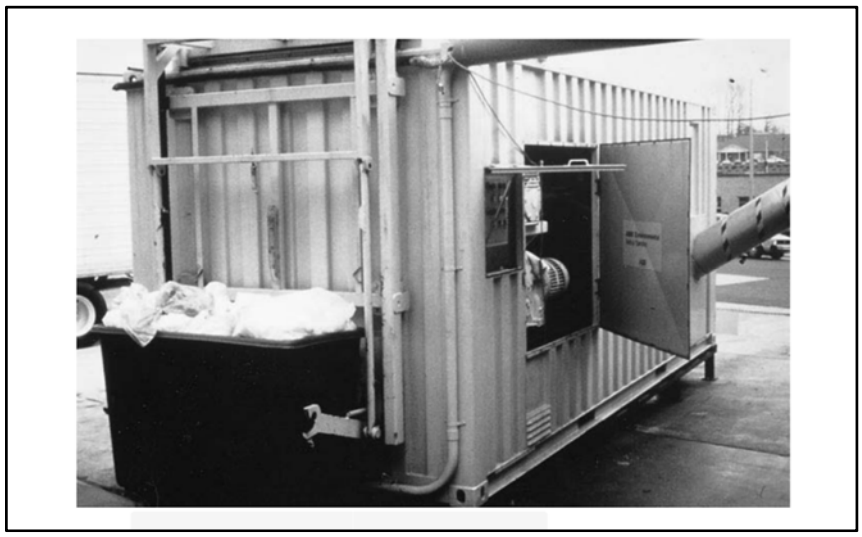
b. Sanitary landfills

These are designed to have at least four advantages over open dumps: geological isolation of wastes from the environment, appropriate engineering preparations before the site is ready to accept wastes, staff present on site to control operations, and organized deposit and daily coverage of waste.

c. Small burial pit for health-care waste



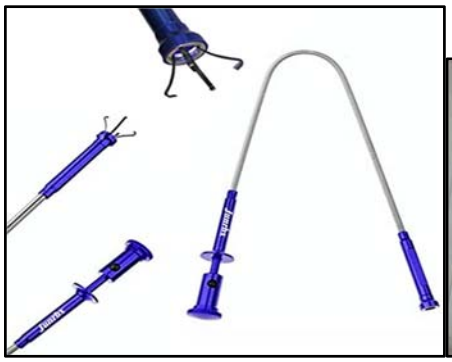
A special small burial pit could be prepared to receive health-care waste only. The pit should be 2m deep and filled to a depth of 1–1.5m. After each waste load, the waste should be covered with a soil layer 10–15cm deep. If coverage with soil is not possible, lime may be deposited over the waste. In case of outbreak of an especially virulent infection (such as Ebola virus), both lime and soil cover may be added. Access to this dedicated disposal area should be restricted, and the use of a pit would make supervision by landfill staff easier and thus prevent scavenging.

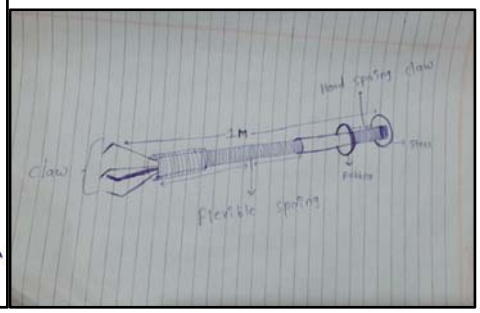


2. **Products available in the market (Product Review) for COVID Waste collection , Segregation and Disposal for residential area**

ARM to Pick up the material (mask, Gloves)DMI Ergonomic

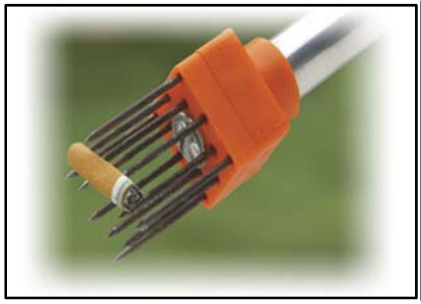
a. Lightweight Reacher Grabber with Rotating Claw and Magnet, Black





b. Claw tool for picking

c. Gandhi chhadi



d. Pointed garbage collection tool

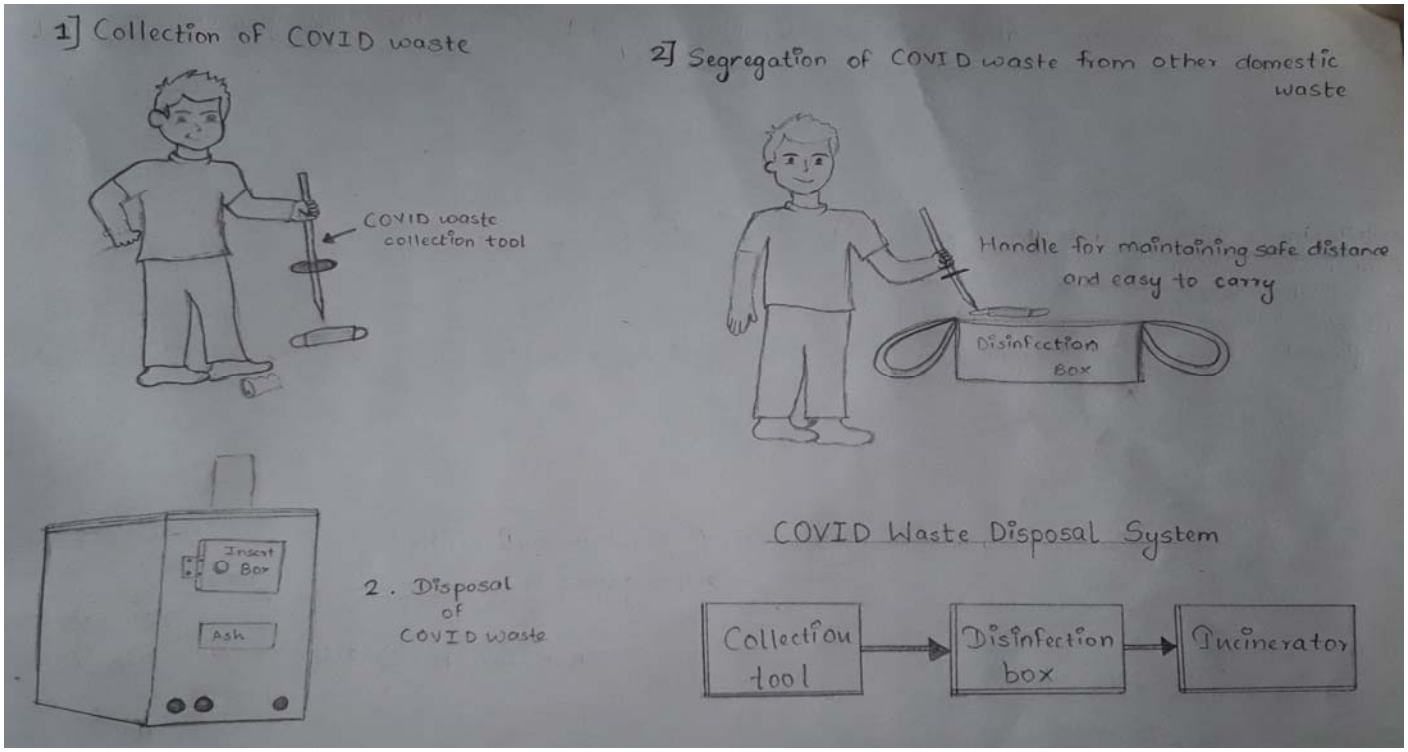
e. Gardening tool for pick up

f. Fruit picking tool from Shristi

3. Multiple Issues and possible solutions (Innovation Ideas)

1. We can make a system which will pick up material laying on the road or from the area through an ARM mechanism and will drop that mask into the box. In the box we will collect masks and gloves and when the box is filled it will get sealed.
2. We can make the arm, at the upper side of the arm we'll connect the rotary switch, Through the rotary switch we will handle the palm direction of the arm.
3. We can make a device, if we apply that device on our mask, so the device will detect whether we can use this mask or not. if we cannot use that mask, it will show us a Red signal and if we can use it, then it will show us Green signal.
4. We Can make very small particles of the waste and when all that material is broken into small pieces, then the device that will detect whether this material contains coronavirus or not.

Concept:



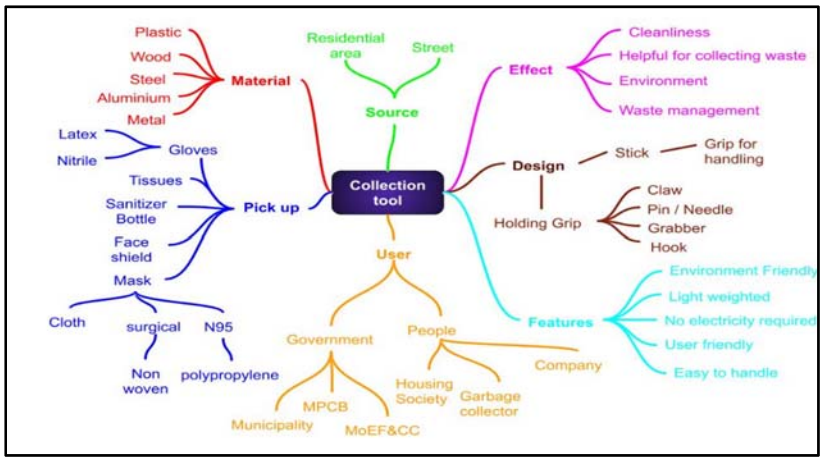
Our system will be having 3 components

- Collection Tool - Disinfection Tool - Disposal Tool (Incinerator)

The Entire system will be designed and developed for the rag pickers and garbage collectors considering safety and health is a prime element during this pandemic situation. Our team focus will be to develop and design waste collection and disposal tools.

1. **Collection Tool**

Mind Map



During our interaction with waste collectors, we found government authorities provided them masks, gloves and other tools which are required during the collection process in market places, residential areas.

During waste collection on the road and public places these people suffer to pick up masks and gloves which are lying on the road, as the waste can't be picked with the available tool. During this condition they need to pick up these waste materials by hand which may be harmful.

Considering this condition, we decided to design a Collection tool which will be helpful for these people. The tool can pick up and hold masks, gloves from a safe distance easily.

We researched based on ergonomic design aspects for collection tools. Based on information we selected a few relevant tools and prepared a chart considering these design aspects

Sr no	Parameters	1	2	3	4	5	6	7	8	9	10	11	12
1	Grip	Pistol Grip (Handle)	Ergonomic pistol grip(Handle) Nifty Nabber Trigger Grip	Ergonomic pistol grip (Handle)	plain stick	Button slide	4 claw grip(pick up)	Clip	Wide Jaw	Patented claw	Tong Picker	Vacuum	Articulated claw
2	Length	18 inches	32 inches	30 Inches	--	42 inches	12.3 inches, 23 inches	57 cm	47-inches	37 inches	35 in	152 mm	5.5 meters
3	weight	---	250 gm	430 gm	400 gm	400 gm	110 gm	150 gm	600 gm	600 gm	Light	200-500 gm	850 Gm
4	Material used	Carboard, straw, thread	aluminum alloy, anti-slip material	Aluminum, plastic	Pin	Aluminum, Stainless Steel	Iron,Chrome Plated,Corrosion-resistant, Spring load	Steel	Aluminum Alloy	Alluminium	-	Plastic, alluminium	Mild Steel
5	Holding technique	Fingers	Holding with hand & pressing with finger	Hand	hand	Button	Press button,hand press	Scissor	hand	hand press	rubberized ergonomic handle	Press button	Hand

6	Cost (Economy)	20 Rupees approx.	700	1000	300	700	306-1016	500	-	-	1,663	3730	781
7	Photo												
8	Uses popularity	School project	Hospital , hotels, malls, raliway,grounds maintenance tools are the solution for picking up rubbish and/or unpleasant objects	cleaning	Troubled areas	Cleaning	Home, dark areas,Indoor and outdoor	Golf ball picker	Snakes, Reptile	Dogs	home and around the yard	home	Fruits
9	Sustainability	10-20 uses	1 months	1 months. 3 Months	Maintenance	1 month	No Warranty	1 months	-	-	180 day	1 Year	no warranty
10	Tool use to pick up (purpose)	Coke bottles, light	Stray litter, trash Picker	Waste picking. Collecti	waste	garbage picking	grabbing under furniture, in crevices	Golf ball picker	Standard Snake Tong Reptile Grabber	Dog Waste Pickup Tool	Multi-purpose pick-up and	Vacuum Pickup Tool	Articulated fruit picker

		weighted things		on grabber			& down drains. Flexible steel stem with a spring-loaded plunger to open and close jaws.				clean-up tool		
11	Feature	It works as Human hand	Anti- slip material used for collection . Lightweight aluminum reacher features rubber-tipped grippers to prevent damage. light-weight design enables greater	Making the process 100 time fast and tireless.Ideal for those with arthritis & limited mobility Lightweight & durable reaching aid for comfort	Can collect from troubled areas. Priced at Rs. 250 It can pick up paper, cardboard, plastic sheets, rubber, cloth and plastic One can pick up 20-25 pieces of waste	Ejects debris. nylon strap add convenience for handling and storage. Includes a safety guard for tip protection Lightweight design for ease of use	Flexible, Magnetic Pickup Tool Features a Powerful White LED Light. Chrome plated, Corrosion-resistant, Spring load	Have clip like mouth to hold ball.	Foldable Professional with Lock Non-Slip Handle	Lightweight and durable non-corroding aluminum tube frame & claws; folds for compact storage	Heavy-Duty Grabber, Comfortable handle and rubberized jaws allow for easy retrieval of objects high and low	Easy, durable	angle of the tool head can also be adjusted for ease of use in hard to reach areas, gentle pull action drops fruit into the strong collection bag

			wrist flexibility and less arm stress, MAGNETIC TIPS, 360`ROTATING HEAD and smooth-action TRIGGER GRIP.	and ease Easy-squeeze trigger control and folds away neatly for storage Easy to use with a large, easy-grip trigger handle that operates the grabber Long-reach grabber extends nearly 3 ft	before needing to unload the collected waste in a bin or bag								
12	References	https://www.youtube.com/w	https://www.indiamart.com/	indiamart.com/proddetai	https://swachhindia.ndtv.com	https://www.amazon.com/Pi	https://www.amazon.com/A	https://www.full2shopping.in/pr	https://www.amazon.com/SUNK	https://www.amazon.in/Super-	https://www.homedepot.com/p/Et	https://www.indiamart.com/prod	https://www.indiamart.com/

		atch?v=c9FuPdl3xCE	proddetail/litter-picker-135554101 30.html	l/waste-picker-2521981788.html	/gandhi-chhadi-the-innovative-stick-that-picks-waste-without-hand-contact-9341/	kStik-T-422-T422-42-TrashStik/dp/B0018N0W42/ref=pd_lpo_201_t_0/147-9099097-8418256?_encoding=UTF8&pd_rd_i=B0018N0W42&pd_rd_r=f6ef42f9-7120-4a4e-a07d-10541a553827&pd_rd_w=KSIxK&pd_rd_wg=qSCGi&pf_rd_p=7b36d496-f366-4631-94d3-	ilenyun-Claw-Type-Magnetic-Pick-up-Flexible/dp/B07C4C4843/ref=zg_bs_331033201 1_12?_encoding=UTF8&psc=1&refRID=WZQXX0VQPBZQE8HG8A0Y	oducts/1060973?variant=16301110362146&currency=INR	Y-Aluminum-Foldable-Professional-Standard/dp/B07BNG3ZQZ/ref=zg_bs_3310332011_50?_encoding=UTF8&psc=1&refRID=WZQXX0VQPBZQE8HG8A0Y	Scooper-Waste-Pickup-Tool/dp/B003N2ZVCE	tore-35-in-Heavy-Duty-Grabber-with-Ergonomic-Curved-Handle-49135/309992593	detail/vacuum-pickup-tool-2633795188.html	proddetail/articulated-fruit-picker-221245869 12.html

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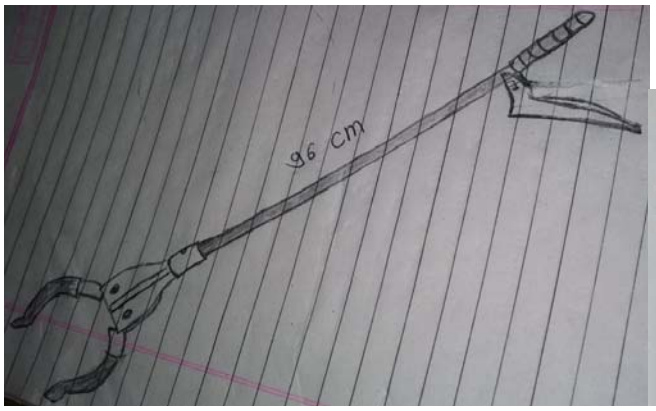
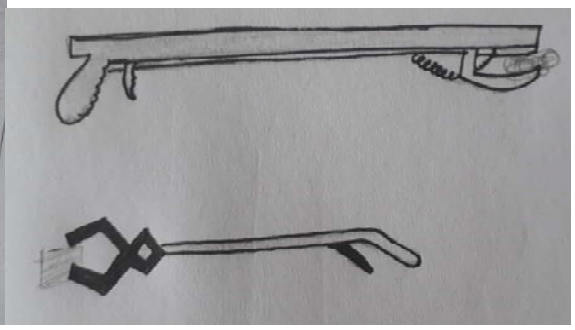
			https://www.amazon.com/Foldable-Mobility-Reaching-Extension-Mazarine2/dp/B07GTWWJB5/ref=zg_bs_3310332011_1?_encoding=UTF8&psc=1&refRID=C	https://www.amazon.in/Extending-Grabber-Litter-Rubbish-Helping/dp/B07N6C4S22/ref=sr_1_3?dchild=1&keywords=trash+picker&qid=1		https://www.homedepot.com/p/Ettore-Trash-Picker-49042/204267908	https://www.indiamart.com/proddetail/flexible-pick-up-tool-34214283 73.html	https://www.banggood.in/Garbage-Clip-Golf-Ball-Picker-Extend-Trash-Pickup-Tool-Universal-for-Car-Home-School-p-1060973.html?cur_warehouse=CN					https://www.indiamart.com/proddetail/fruit-picker-rgm-21369639033.html

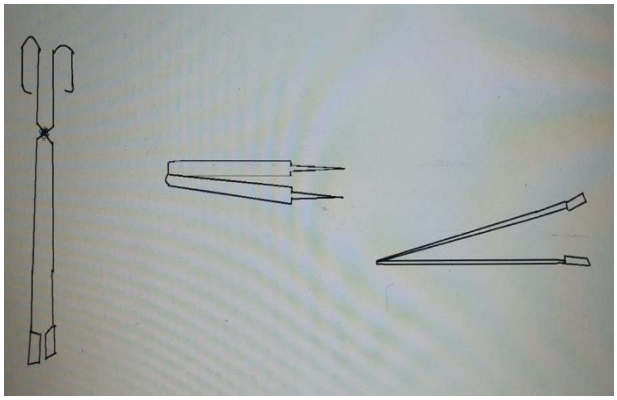
			A8XSWVAQF2G55BDRX48	591354821&sr=8-3									
			https://www.amazon.com/Unger-Professional-Nifty-Nabber-36/dp/B0000V0AGS/ref=sr_1_7?dchild=1&keywords=waste+picker&qid=1591376252&sr=8-7	https://www.amazon.com/COJOY-Suction-Cup-Reacher-Grabber/dp/B015LSL99G/ref=sr_1_23?dchild=1&keywords=waste+picker&qid=1591376403&sr=8-23									

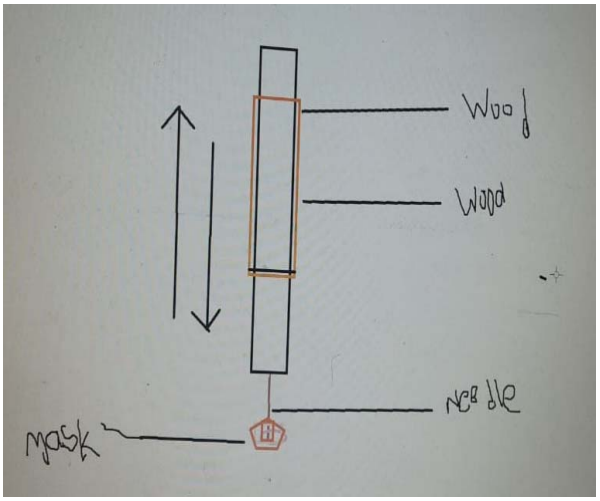
Sketches of the collection tool

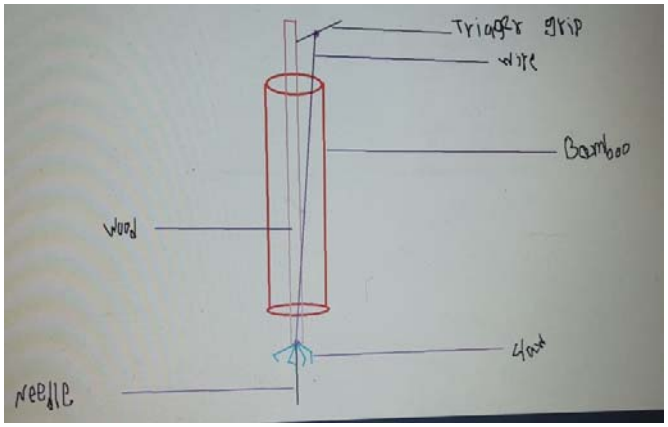
Before making mock up models we sketch a few tools to brainstorm.







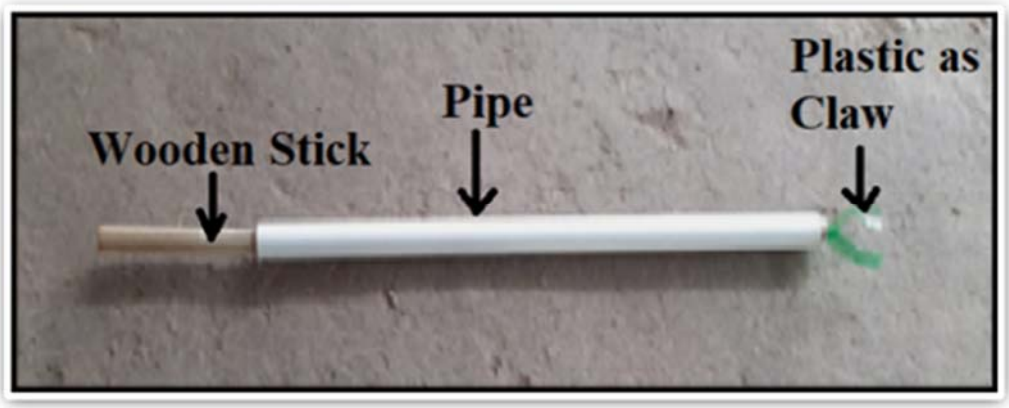


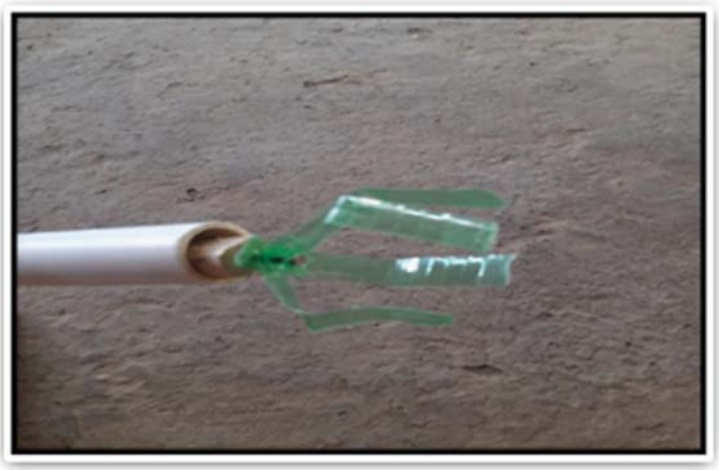


These are our sketches used for brainstorming before coming to conclusion and making a mock up model. During the sketch we came to know that the design of grip for holding differs from material to material. So, we drew all the mouth shapes and grip for holding available in tools for picking or holding things.

Following are our mock up models:

Model number 1





Working:

A wooden stick is inserted inside the UPVC pipe. Top of the plastic bottle is carved in the shape of a claw and attached to the wooden stick. When we push the wooden stick, the claw is opened and catches the things similarly when we pull the wooden stick, the claw goes inside the pipe so it holds the things.

Observation:

We can pick up everything which is light in weight. It has a good grip and holds things properly. We can pick up things simultaneously.

Model Number 2

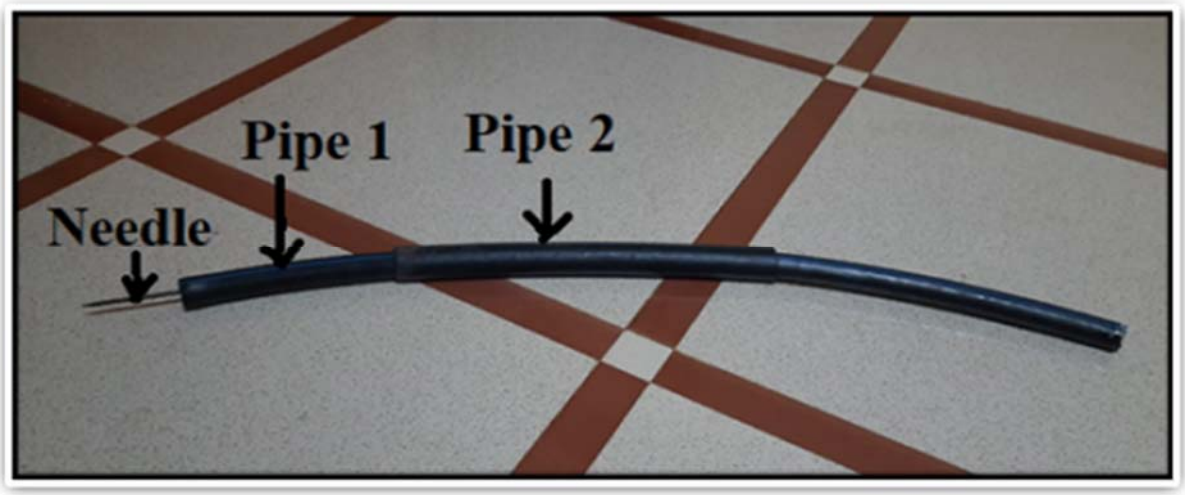
Working:

It works like a sweeping broom. Things get stuck in the needle easily and also hold as the stick is bent so the needle is tilted.

Observation:

As model no 1 can hold only one thing at a time so this model no 2 has overcome it. It can hold things as much as the size of a needle is.

Model number 3:



Working:

There are 2 pipes inside one another. In pipe 1 a needle is attached and pipe 2 is used to remove the waste attached in the needle.

Observation:

We can remove waste without touching it.

Summary of mock up model:

- When we took trail of model 1, we understand it pick up and hold thing very well but we can pick and realize waste one by one. Also, in rainy season it is difficult to pick up waste form crooked areas.
- In model 2, we can pick up waste simultaneously and also holding it as it has tilt mouth but we cannot drop or realize waste.
- In model 3, we can pick and also drop waste simultaneously.

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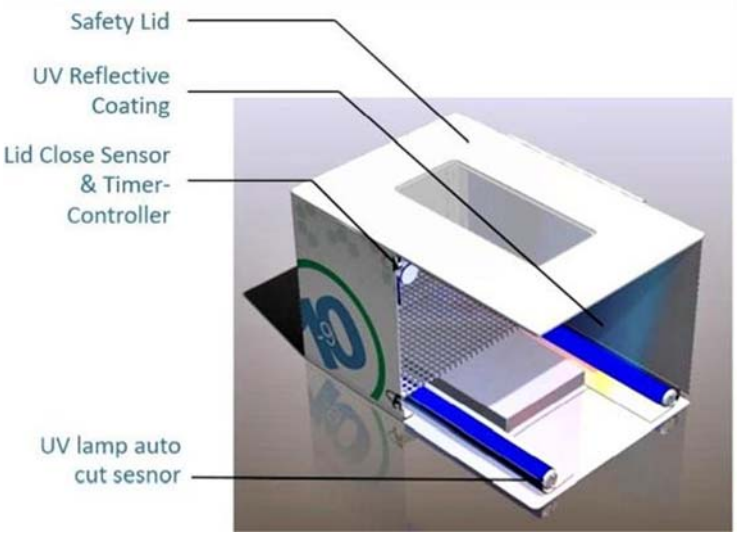
2. **Disinfection Box**

After collection of waste, waste collectors transport it to the landfill. But during this pandemic situation if any mask or glove contains virus then it will be harmful for the waste collector. Considering this issue, we thought to build / use disinfection boxes.

After collecting masks , gloves before transportation waste collectors can put those things in this disinfection box. In this box these waste materials will disinfect which later can be transported. It will assure safety of the worker to the extent during transportation of the waste.



Proposed disinfection box description:

We found UVGI light (The germicidal range of UV is within the 100-280nm wavelengths, with the peak wavelength for germicidal activity being 265 nm. This range of UV light is absorbed by the DNA and RNA of microorganisms, which causes changes in the DNA and RNA structure, rendering the microorganisms incapable of replicating) is an excellent technique to disinfect the COVID waste.

Garbage pickers / collectors will place collected used masks or gloves inside the box. This machine will exhibit UV light and disinfect the material placed within.

Reference:

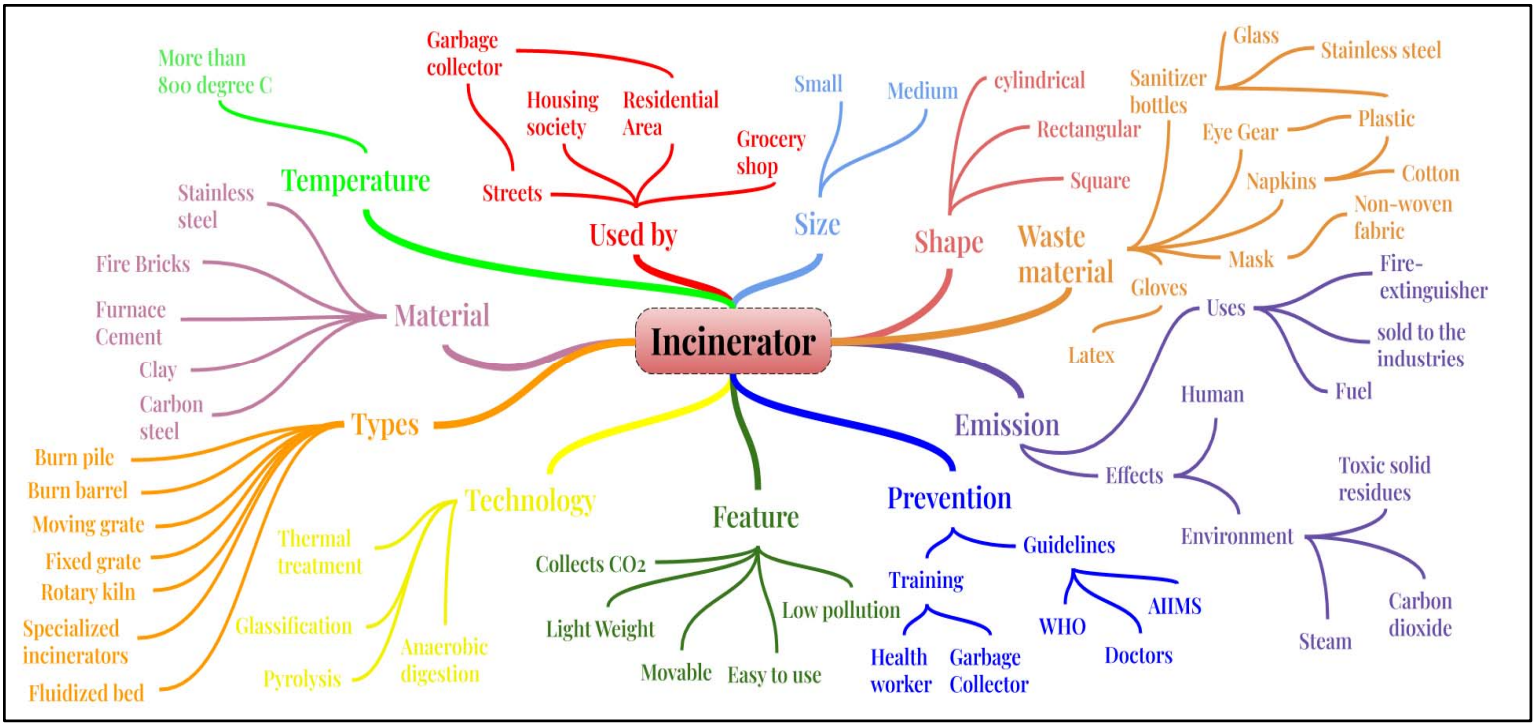
https://coronaoven.com/

3. Disposal Tool (Incinerator)

During discussion with the waste collector we found that transported waste goes to the landfill which gets mixed further with other household waste.

To avoid this, we decided to include a disposal tool in the system. Our covid waste disposal system for residential areas will not only collect waste but also dispose it.

Mind Map



For burning of medical things like masks, face shield or gloves, a research was done to find materials used, its use time which determined washable or not and its limitation of use till expiry and thus we further characterized its disposability.

Types of Masks and its Characteristics:

Sr. No.	Types of mask	Material	Use time	Disposable
1	Surgical	Non-woven fabric	1-time use	Yes

2	N95	Electrostatic non-woven polypropylene fiber	Washable	Yes
3	FFP1	Polypropylene Melt blown Fabric	1 time	Yes
4	Activated carbon	Activated carbon sponge	100 hours	Yes
5	Cloth & sponge	High-thread-count cotton, natural silk, and chiffon	Washable	Depends
6	General-purpose doctor Green mask	Cotton	Depends	No

Starting with 60 ºC till 800 ºC we took certain levels in which we came to know and were able to classify the materials disposal temperature accordingly. Also, which shape and size is predicted to the type of materials so it got characterized further with addition to its emission of gases while burning.

Incinerator details with Various type of temperature conditions and its emission

Sr no	Temperature	Material	Shape	Size	Gasses
1.	**60** ºC	Incomplete composition of fossil fuels	Cylindrical pipe	Diameter-10.3mm to 50mm length-6.4m	Methane, carbon dioxide, carbon monoxide, nitrogen, sulfur dioxide and hydrogen sulfide, with methane
2.	**110** ºC **-200** ºC	Latex	Fixed grate	95 cm height, 105 cm length	Natural gas, gasoline, petrol, biodiesel blends, diesel fuel, fuel oil, or coal
3.	**200** ºC **-390** ºC	Non-woven# melt blown	Irregular shape	Standard	Carbon gas or black smoke
4.	**300** ºC **-400** ºC	Cotton	Rectangular	Standard	Gas oil, liquefied gas
5.	**600** ºC **-800** ºC	Synthetic plastic fibers	Cylindrical Drum	55 gallons (22.5-inch diameter, 33.5	CO, CO2, NOx

				height)	
6.	**600** ºC **-800** ºC	Plastic	Irregular shape	9 meters height, 3-6 meters ground	Fuel gas, heat, carbon

Incinerators are built from many years and its technology determined a particular incinerator with its waste disposal. But due to prevention from toxic gases which polluted the environment, the most percentage among the rest of gases was carbon which emits while burning many types of waste in a large number. By the reference we were able to characterize the carbon footprint.

Technology used in incinerators for particular waste, its material and carbon footprint table:

SR No	Technology	Incinerator	Material	Waste	Carbon footprint
1	Burn pipe/ box	Auto-combustion	Steel pipe	Incomplete composition of fossil fuels	81.5773 (kg/cm²)
2	Burn barrel	Private waste incinerator	drum	Synthetic plastic fibers	5.1 kg(more than double)
3	Fixed grate	Direct flame	Cast iron grates	Latex	3.34 kg(half of)
4	Specialized technology	Specialized incinerators	Fire bricks, metals	Latex, plastic, cotton	3.34kg 5:1ratio(4 times more) 136.078
5	Waste to energy	Moving grate	Alloys	Non-woven, plastic,	2 times more 5:1ratio(4 times more)

Selective and improvement specification with reference of other researched incinerators and its drawbacks which came with a solution for designing and arranging for our incinerator.

Sr. No.	Parameters	1	2	3	4	5	6	7	8	9
1	**Product Name**	Food Wet Waste Crusher With Remote Air Switch	Napkin Incinerator MSMAXS 200	Ashing/Burn off furnaces	Office Model	EASYBURN	Zexter Carbon Steel Portable Incinerator	Indo Med Electrical Mask Incinerator Machine	Aimecs Portable Waste Incinerator	SAPI BURN MS
2	**Type of waste**	Food Wet Waste Crusher	Napkin	All waste	Napkin	Sanitary Napkin Disposal & Small Clinical Waste	Solid waste	Mask Disposal	GENERAL WASTE	Solid waste incinerator
3	**Temperature**	-		1100 ℃						
4	**Weight**	5kg								850 KG
5	**capacity**	2 kgs to 4 kgs / Day	12 storage, (12 Hours-200, 24 Hours-100)	7.20l	5 Napkins (70 napkins per day)	25 Napkins Per Cycle		10-15 Per Cycle,(200 Napkins/ Day)	20 kg/batch(100 Kg/time)	burning ability 500 KG

6	**Dimensions**	22.6 × 22.6 × 46 cm	230 x 285 x 500	435 x 740 x 655	*270 x 250 x 370*	250Lx 250Bx 600H				
7	**technology**	Multi – stage grinding system in – built	Advance fully automated technology	GSM 11/8		Automatic Timer Cut Off	Portable Incinerator	Solid Waste Incinerator	Solid Waste Incinerator	Portable incinerator
8	**Power source**	Electric	Electric	Electric	Electric	Electric	Electrical	Electrical	NO FUEL	Electrical
9	**Power supply**	560W(3/4 Hp)	1200 W	3000	*1000 Watts*	2000w	240 V 50 Hz	230V +/- 10% or 1.2 KW	-	7.5 KVA
10	**Made-up of(material)**	stainless steel SUS420	Ceramic Insulation, MS CRCA IS 1513 D Grade		*MS Powder Coated*	epoxy coated sheet metal and SS (Stainless Steel)	Carbon Steel	Ceramic insulation for external thermal protection	Carbon Steel	MS, Bricks & Ceramic Fiber
11	**efficiency**	Motor Speed: 3700 RPM			*100% Automatic*			Auto thermal cut off for safety of user		Thermostat andtimer gives long life for Heater and reduce the electricity bill.
12	**feature**	Warranty: 24 Months,	Advance fully automated		Automatic function	Eco-friendly, Helps to	Fine finish, Dimensionally	Emission Outlet: Provided to		Portable/Movable type in Nature, which

		Special PM motor with larger torque for higher performance	technology, easy to use		with button operation	Avoid Drainage Line Chock-ups and having Very easy & Safe Operation	accurate, Highly reliable	let out the flue gas		caneasily place in small Corner of building
13	**Time/ Speed**	larger torque for higher performance				1 Hr		3 Min	4 Hrs	1 HR
14	**Cost**	16,990.00	15799	692,000.00	18,500.00	16,520.00	78,500	12,000	1.2 Lakh	2.5 Lakh
15	**Specification**	FCD 720R (0.75HP), Remote Air Switch	Wall mounted, Auto thermal cut off	Precision incinerator GSM 11/8 max. temp. 1100°C, with controller E301	*3 Steps*	2 Inch Flexible House		Timer LCD Display, Power Saver		IF NEED EXTRA CHARGE-air blower, DOUBLE CHAMBER
16	**Brand**	Bin Crusher Clean & Green	Virgo SaraEquipments	Carbolite	Shri Ramm Inc		Zexter	INDO MED	Aimecs	SAPI BURN
17	**Link**	https://www.bincr	https://www.virgosara	https://www.labfriend	https://shriramminc.co	https://www.sanitaryn	https://www.indiamar	https://www.indiamar	https://www.indiamar	https://www.indiamart.com/prod

		usher.com/product/fcd-720r-0-75hp-food-wet-waste-crusher-with-remote-air-switch/	.com/view-products.php?id=12	.co.in/ashingburn-off-furnaces-4781	m/product/sanitary-napkin-disposal-machine/	apkinvendingmachine.com/shop/easy-burn/easyburn-compact-otheb522/	t.com/proddetail/portable-incinerator-644542856 2.html	t.com/proddetail/mask-incinerator-machine-221612513 97.html	t.com/proddetail/portable-waste-incinerator-136924948 88.html	detail/portable-incinerator-22023017397.html
		https://www.amazon.in/Pureflames-Tidy-Food-Waste-Disposer/dp/B07SZ4MWVS?source=ps-sl-shopping ads-lpcontext &psc=1	https://www.virgosara.com/view-products.php?id=2			https://www.indiamart.com/proddetail/school-sanitary-napkin-destroyer-22278047888.html				
		https://www.shopc	https://www.virgosara			https://www.indiamar				

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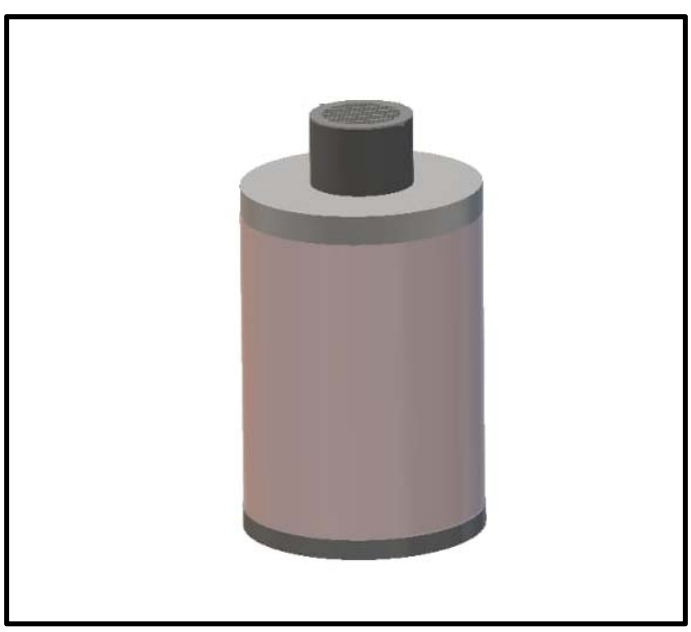
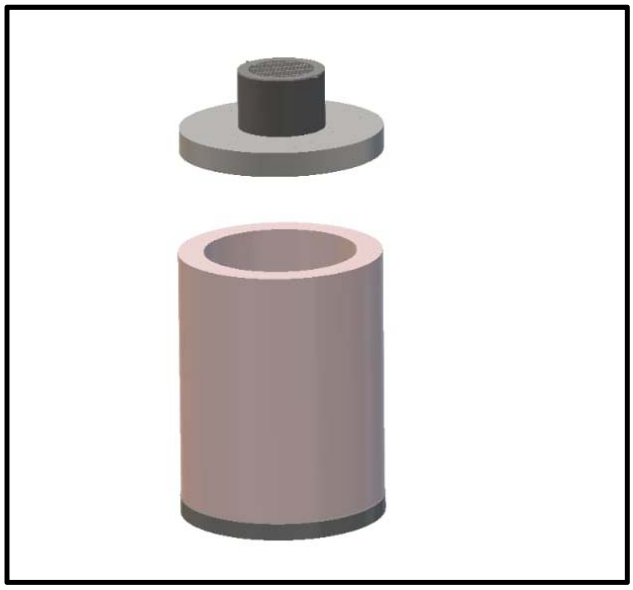
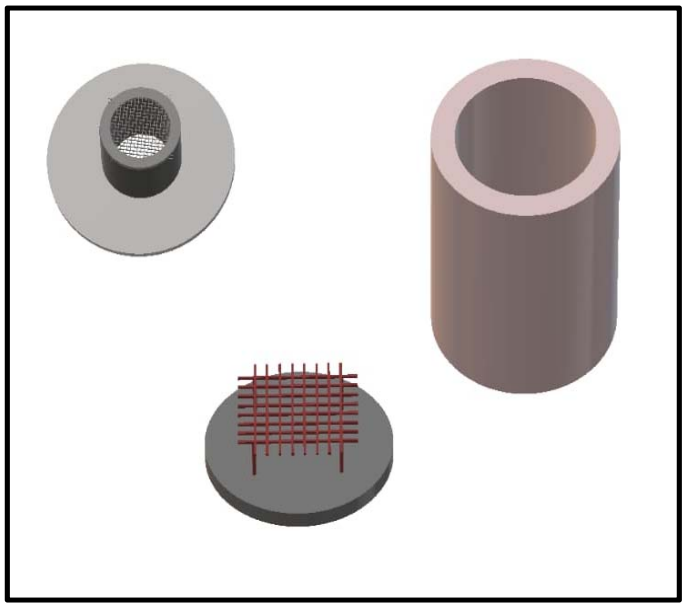
Mock up Model for Incinerator

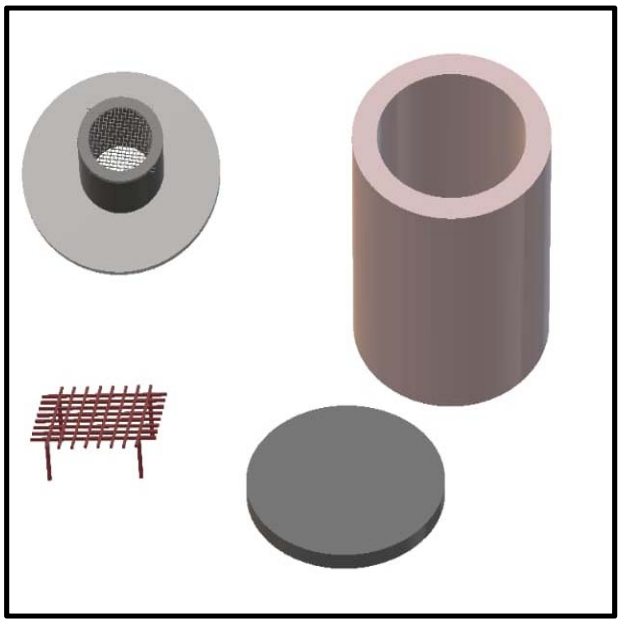
We build incinerator 3D models and one mock up model using cardboard boxes.

1. Cylindrical shape incinerator:

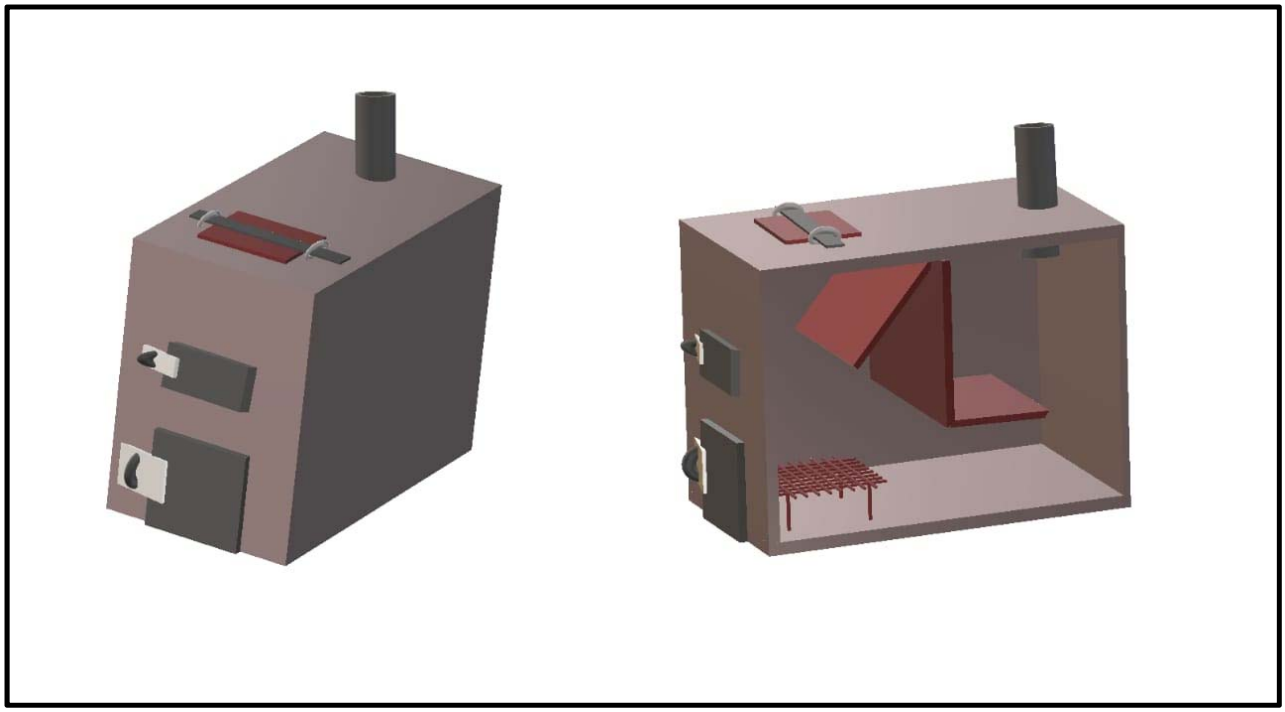








2. Cuboidal Shape Incinerator :



Mockup model of cardboard:

Proposed Specifications of Collection tool

Through our research work we are proposing following specifications for collection tool and incinerator.

Consideration of Collection tool Design aspects

Sr no	Specification	Range

1	Grip	Rubber
2	Length	around 90 cm to 1 meter
3	Weight	200 - 400 gm
4	Material used	Carbon Steel / Plastic / Aluminum alloy
5	Tool use to pick up (purpose)	To pick up, hold and release mask, gloves from any surface

Consideration of end user actual use aspects

6	Gender	Male / Female
7	Comfortable Position	Standing
8	Height of the person	3 feet to 6 feet

Proposed Specifications of Incinerator

Sr. No.	**Specification**	**Range/Percentage/Type**
1	Incinerator	Private waste incinerator
2	Technology	Burn Barrel
3	Temperature	Up to 800 degree
4	Extend residence Time	10- 15 minutes
5	Material	Stainless steel
6	Weight	60- 80 Kg
7	Capacity	5 - 6 Kg
8	Shape	Cylindrical Drum

9	Size	Height- 90.045cm, diameter- 81.075cm

Summary:

There are many guidelines and systematic disposal processes for medical waste which are developed and designed by WHO and many other government bodies. But such a process is needed in residential areas as people are throwing masks, face shields and gloves in dustbins or on the roads. This is harmful for the garbage collectors as it may contain viruses.

Our proposed covid waste disposal system is designed by considering the challenges and difficulties which garbage pickers and collectors are facing in these pandemic situations.

It will be helpful and useful. It will act as a systematic disposal system for residential areas to an extent.

Other References

- Details of Bio medical waste management of Maharashtra state
http://mpcb.gov.in/waste-management/biomedical-waste

- Guidelines by Maharashtra Pollution control board on Covid-19 waste management
http://www.mpcb.gov.in/whats-new-page

- Eye Opening article from Monga bay Series (health and environment) on current situation published on 24th March 2020
https://india.mongabay.com/2020/03/pollution-watchdog-releases-guidelines-to-handle-covid-19-biomedical-waste/

- WHO Statistics for Medical equipment, devices and policies
https://apps.who.int/gho/data/node.main.MEDICALDEVICES?lang=en

- AIIMS Guidelines for Biomedical Waste Management
https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html