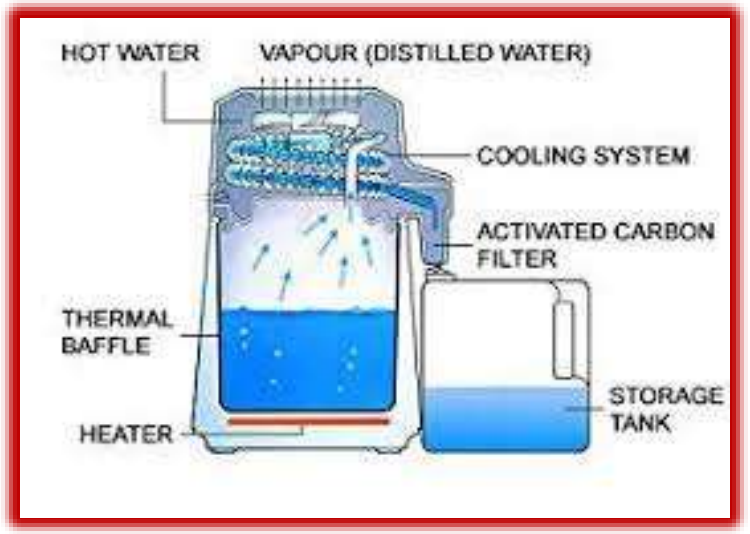
# How to select the best water filter for your domestic use ?




**PREPARED BY : DR.MRINMOY MAJUMDER,FOUNDING EDITOR(HONR), INNOVATE FOR SUSTAINABILITY,HTTP://WWW.BAIPATRA.WS.**
**FIND ME IN RESEARCHGATE AND LINKED IN AS MRINMOY MAJUMDER IN TWITTER AND KUDOES AS KUTTU80**

## Water Filter

How it works ? What filter is useful for what type of contaminants? How to improve the performance of Water Filters ? How to select the best water filter most suitable for you ?

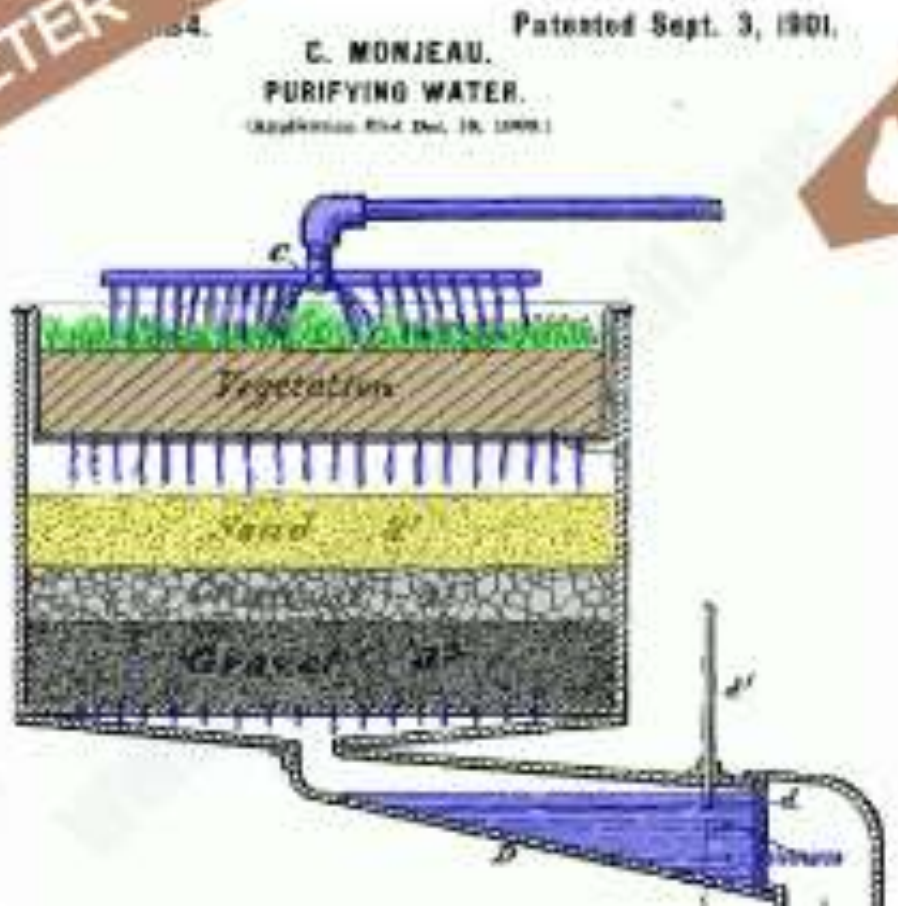
# Common Impurities and how to remove it from water ?

# Different Types of Filters

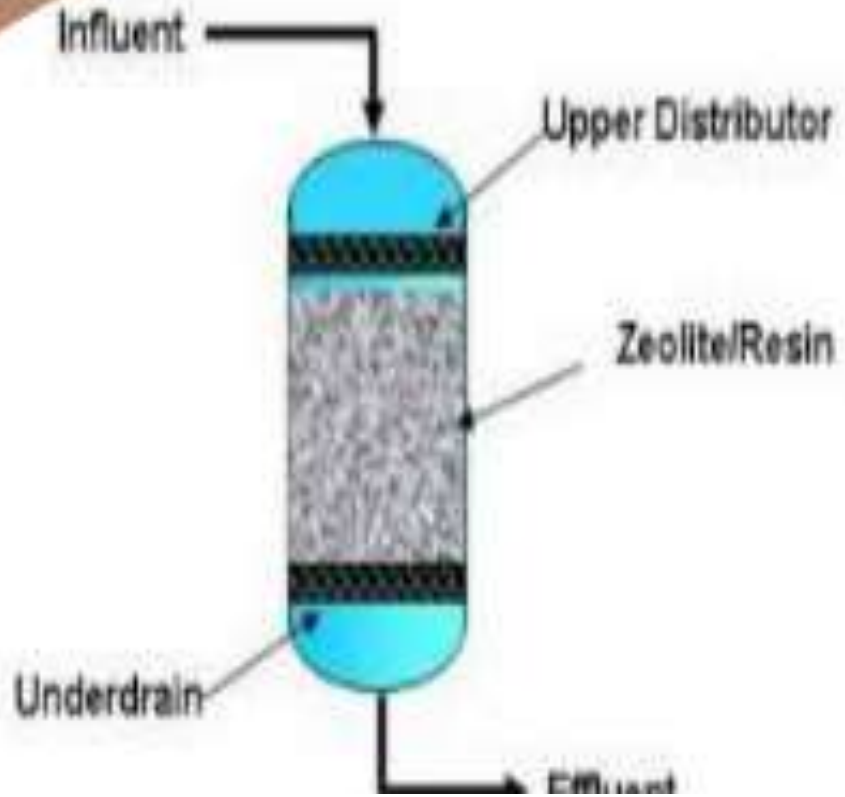
- Broadly filters can be classified into six types :
  - Physical Filters : “filtering by gravity”
  - Ion Exchange : “filtering by exchanging bad ions with good ions”
  - Activated Carbon : “filtering by trapping impurities within pores of carbon material”
  - Reverse Osmosis : “filtering by reversing the process of osmosis thus separating the impurities and water by semipermeable membrane”
  - Distillation : “filtering by boiling”
  - UV Light : “filtering by lights of ultra-violet frequency”

- *A brief description, strength and weakness of the filters are explained in the next slides.*

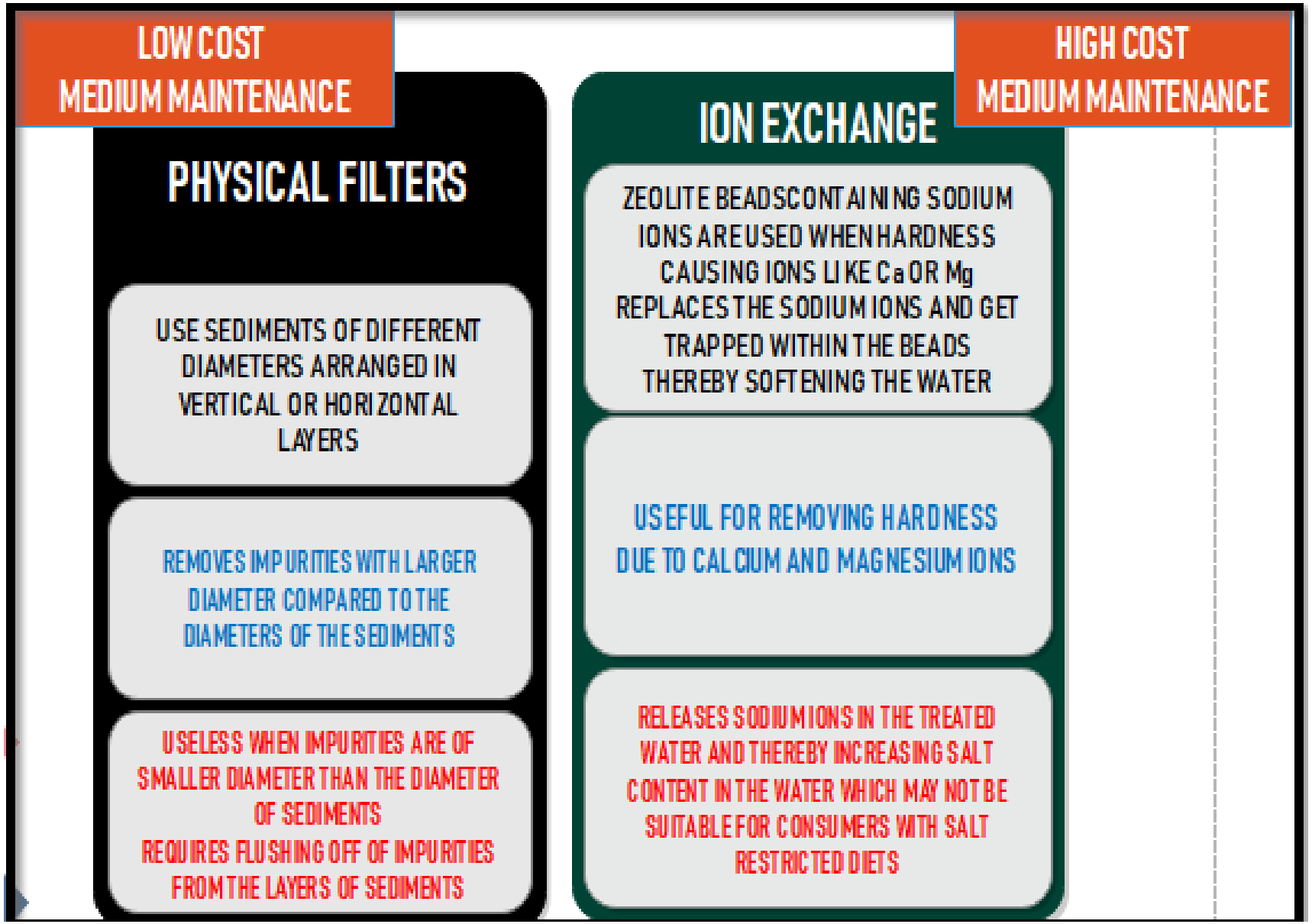
PHYSICAL FILTER



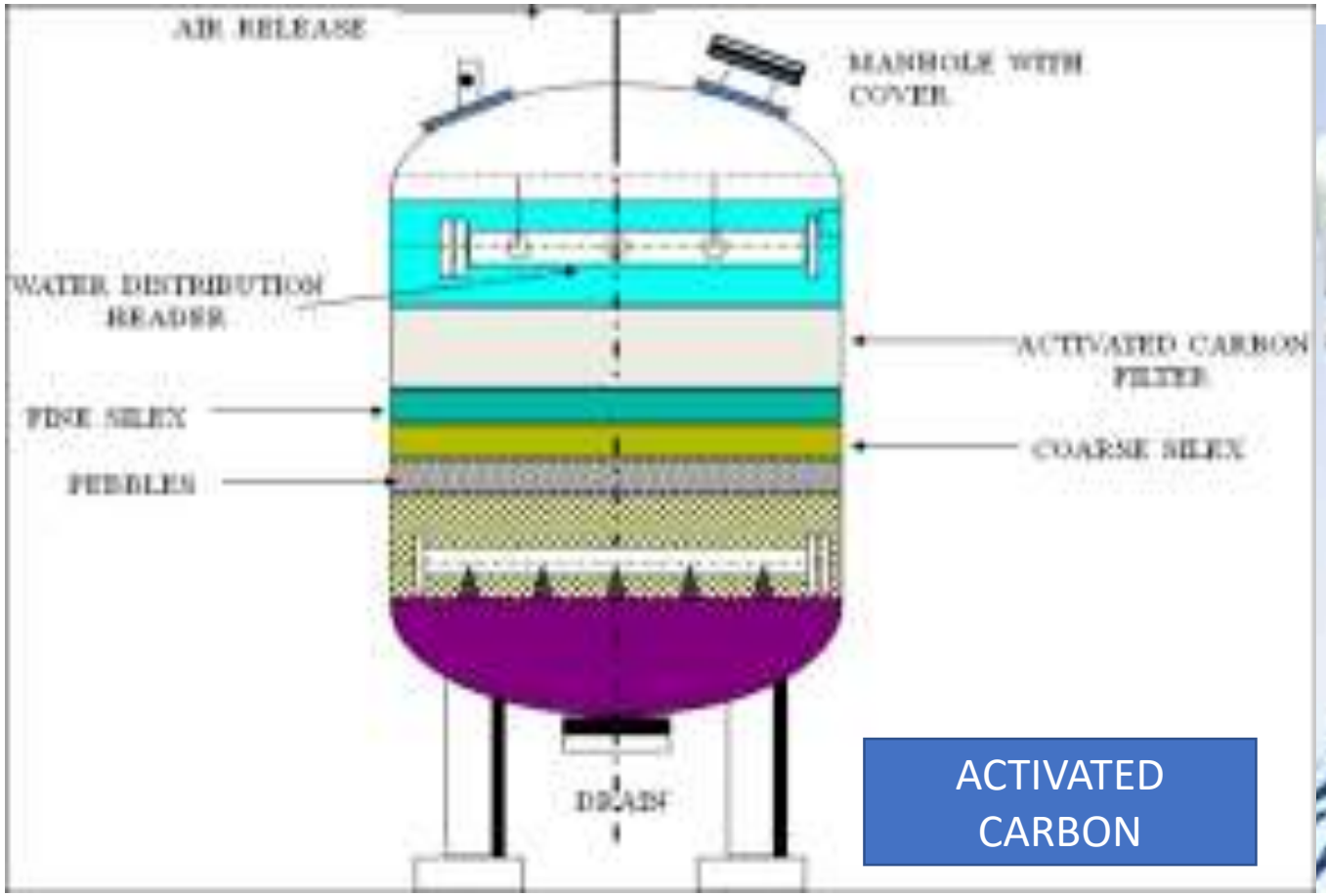

ION EXCHANGER




# Different Types of Filters



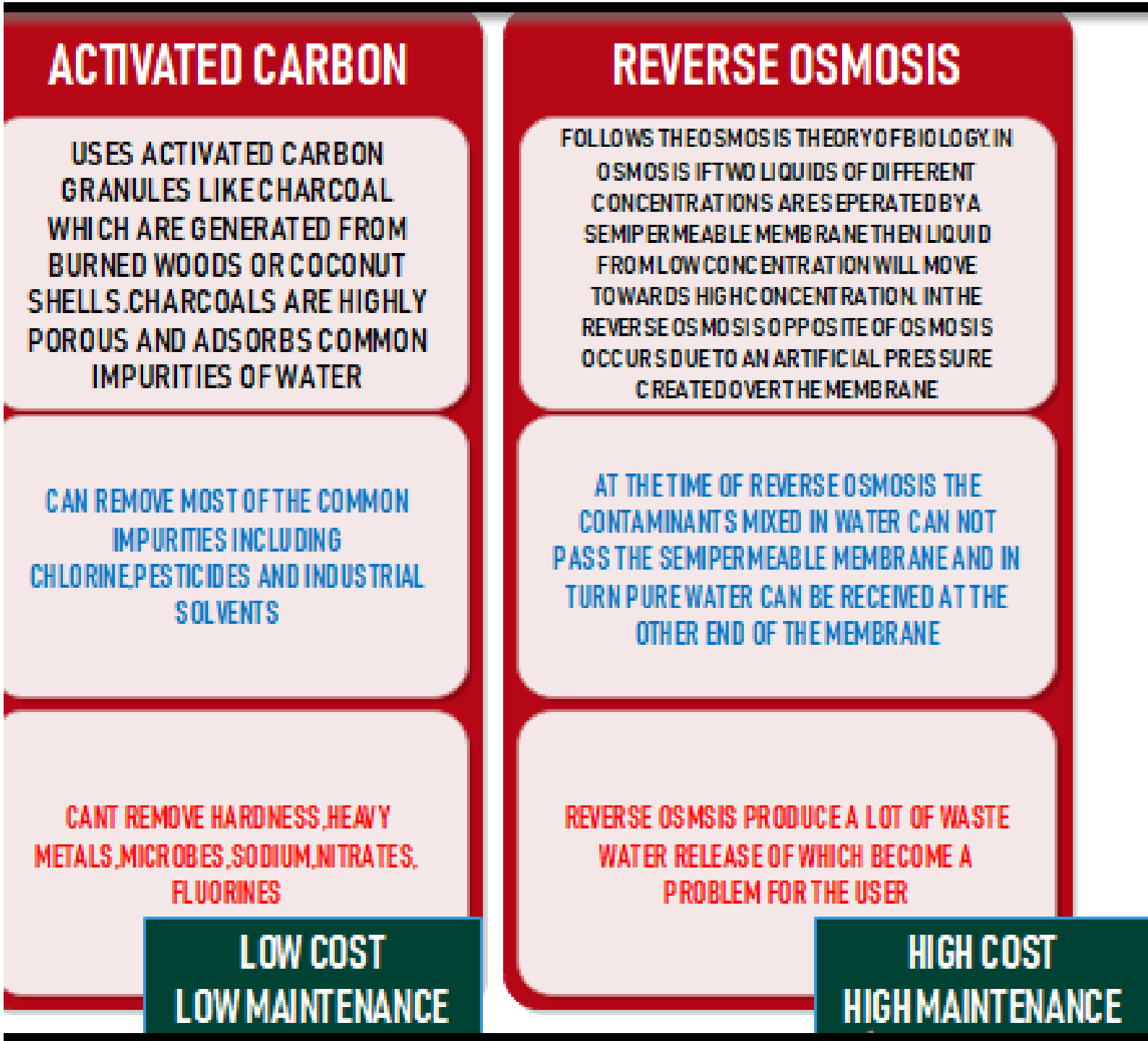

# PHYSICAL FILTERS AND ION EXCHANGE FILTERS



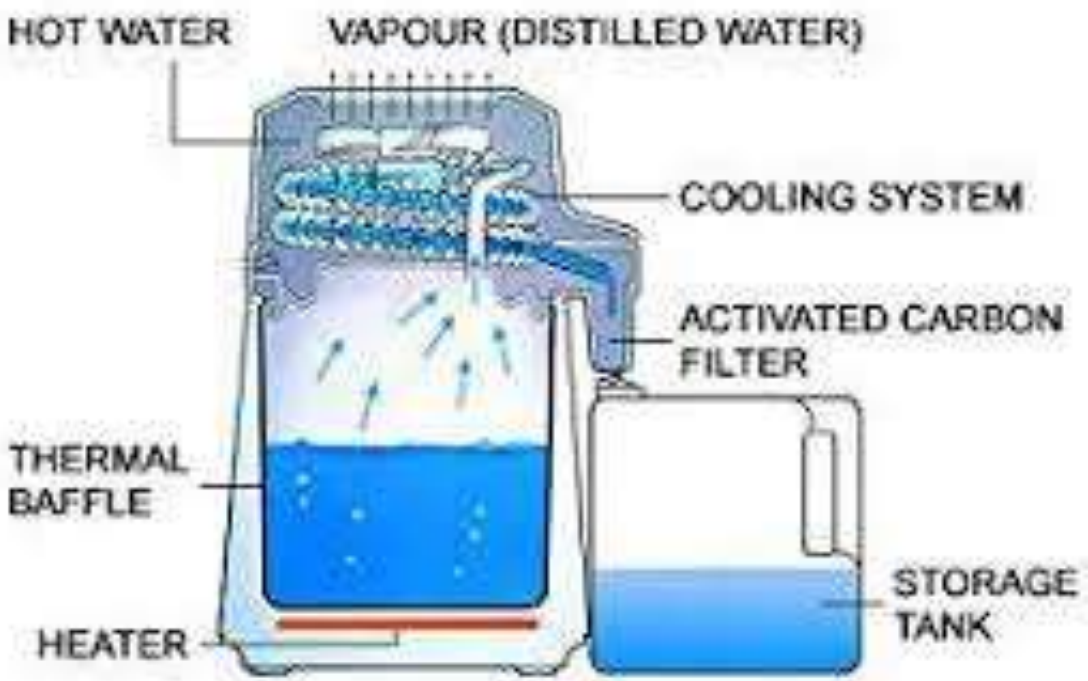

ACTIVATED CARBON

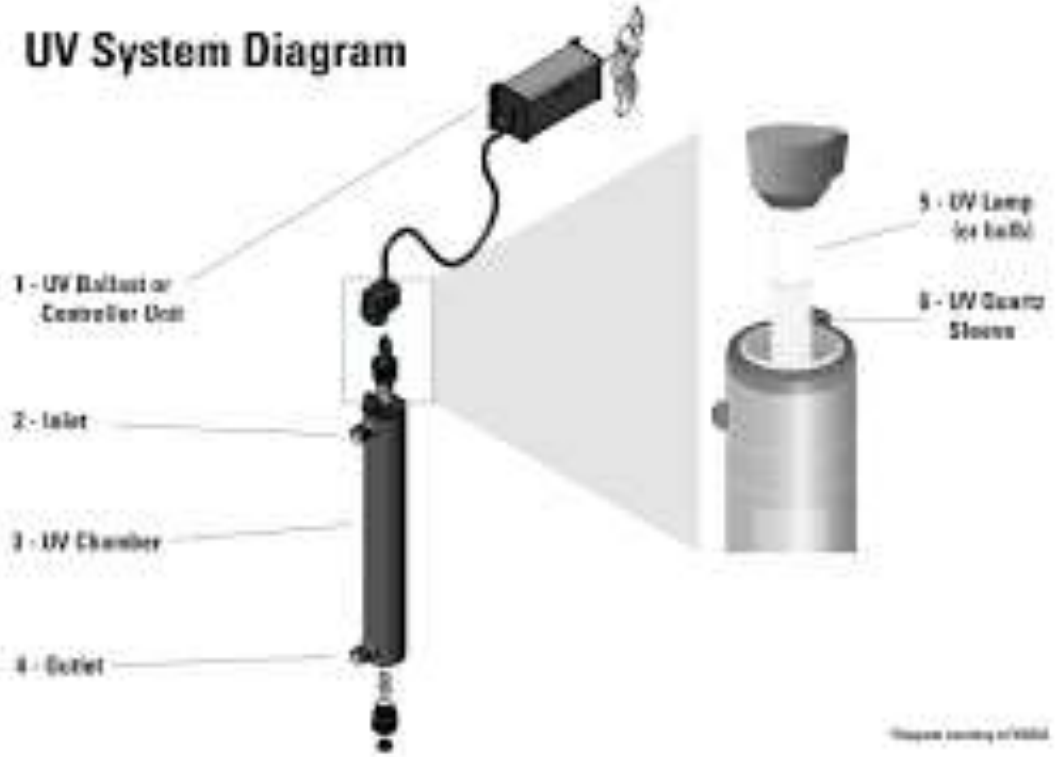

REVERSE OSMOSIS

# ACTIVATED CARBON AND REVERSE OSMOSIS FILTERS

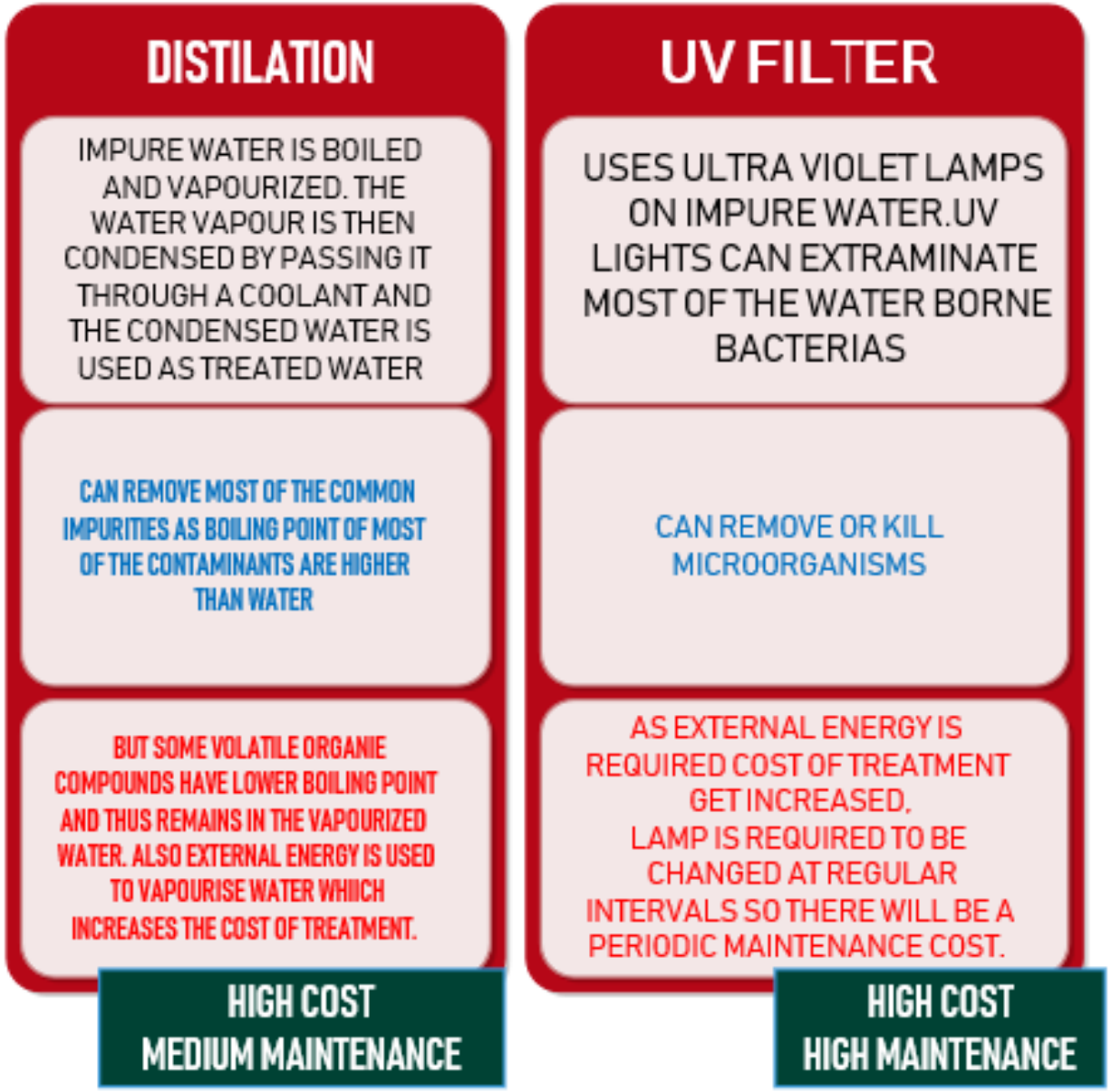


# Distillation vs UV Filters

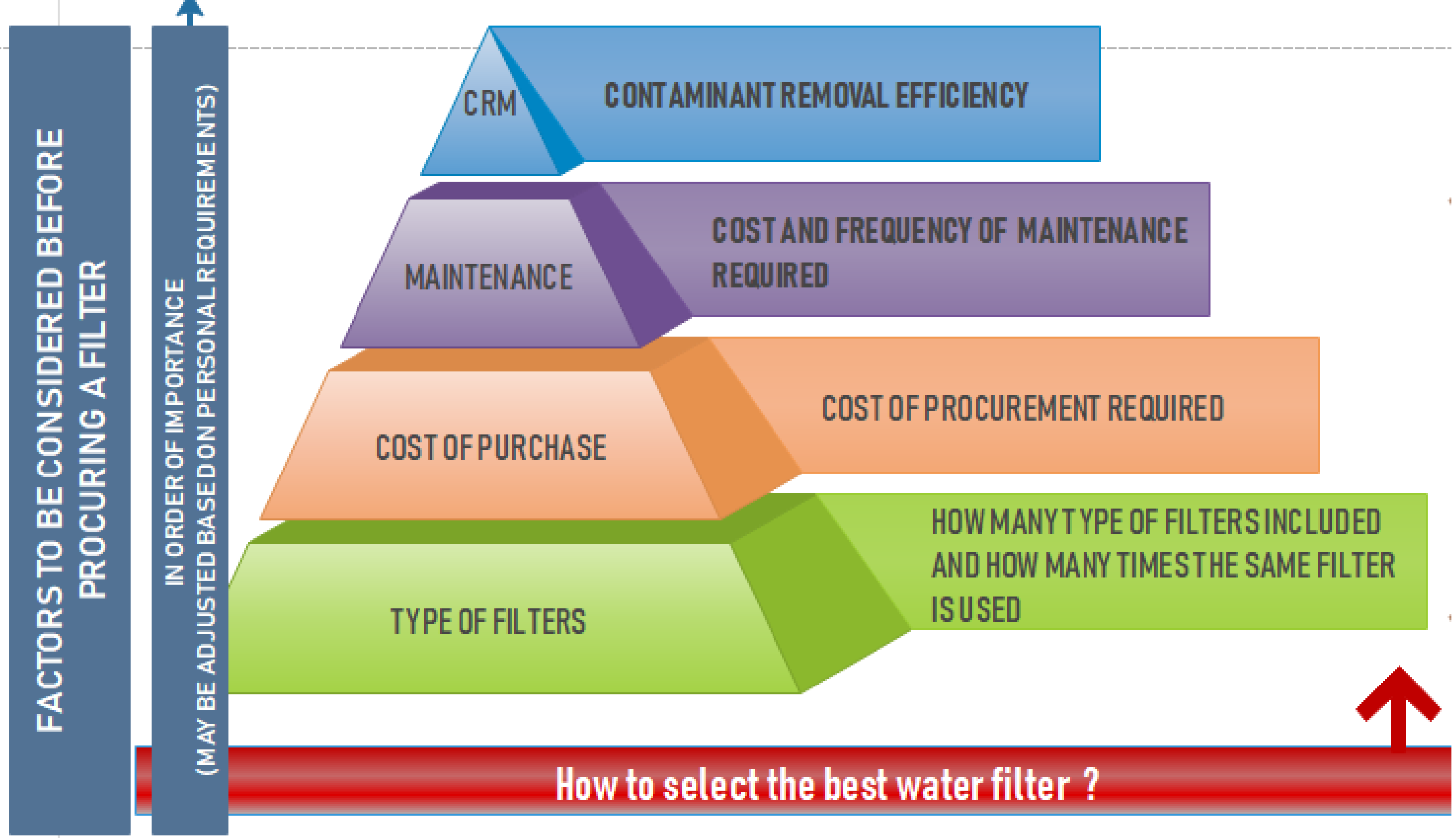


# DISTILLATION AND UV FILTERS



# How to select the best water filter by Simple Decision Maker


FACTORS TO BE CONSIDERED BEFORE PROCURING A FILTER
IN ORDER OF IMPORTANCE
(MAY BE ADJUSTED BASED ON PERSONAL REQUIREMENTS)
CRM
CONTAMINANT REMOVAL EFFICIENCY
MAINTENANCE
COST AND FREQUENCY OF MAINTENANCE REQUIRED
COST OF PURCHASE
COST OF PROCUREMENT REQUIRED
TYPE OF FILTERS
HOW MANY TYPE OF FILTERS INCLUDED AND HOW MANY TIMES THE SAME FILTER IS USED
How to select the best water filter ?

# How to select the best water filter ?

- Step 1 : Go to https://tinyurl.com/y4g2slld. This is the link to a “Simple Decision Maker by AHP” Webware which will help to select the best filter(to be more precise : filter configurations) with the help of some criteria and following the most famous decision making method : Analytical Hierarchy Process(AHP). For more details about AHP go to :

https://learnmetaheuristics.blogspot.com/2019/06/simple-decision-making-tool-following.html

- Step 2 : Select the set of criteria based on which you will identify the best filter among the available options (Go to Slide No.10).
- Step 3 : For example, let four different types of filter configurations are available for procurement. The table in the next slide depicts the cost of purchase, type of filter, number of stages, maintenance cost and frequency and contaminant removal efficiency of the available filter configurations.

| Name of Filter Configurations* | Cost of procurement (INR) | Type of filter | Number of Stages | Cost of Maintenance (INR/six month) | Frequency of Maintenance(per year) | Contaminant Removal Efficiency (%) |
|---|---|---|---|---|---|---|
| Filter A | 2500 | Activated Carbon | 2 | 100 | 3 | 55 |
| Filter B | 3500 | Activated Carbon + UV Light | 2 | 125 | 2 | 65 |
| Filter C | 7500 | Activated Carbon + Ion Exchange + UV Light | 4 | 250 | 2 | 75 |
| Filter D | 15000 | Activated Carbon + Reverse Osmosis + UV Light | 5 | 500 | 1 | 85 |

*Number of different types of filters are arranged to create one filter configuration which is sold to consumers. Normally a filter configuration have more than one stage(Stage means one type of filter). In this example only those configurations which have minimum 2 stages are considered. Same type of filter can also be used in more than one stage.

Note : This example is for demonstration purpose only.

| Name of Filter Configurations* | Cost of procurement (INR) /Rank | Number of Stages /Rank | | Cost of Maintenance /Rank | | Contaminant Removal Efficiency (%) /Rank |
|---|---|---|---|---|---|---|
| Filter A | 2500/ 01 | Activated Carbon | 2 / 03 | 100 | 3 / 02 | 55 / 04 |
| Filter B | 3500 / 02 | Activated Carbon + UV Light | 2 / 03 | 125 | 2 / 01 | 65 / 03 |
| Filter C | 7500 / 03 | Activated Carbon + Ion Exchange + UV Light | 4 / 02 | 250 | 2 / 03 | 75 / 02 |
| Filter D | 15000 / 04 | Activated Carbon + Reverse Osmosis + UV Light | 5 / 01 | 500 | 1 / 03 | 85 / 01 |

**Now try to rank the filter configurations based on its characteristics represented by the selected criteria. It is better to represent Type of filter and number of stages by a single criteria :Number of Stages(as it depend on both type and number of stages) and Cost and frequency of maintenance as : Cost of Maintenance(cost will depend on cost per maintenance as well as number of times maintenance is required per year).**

# How the filter configurations were ranked ?

- For Cost of Procurement and Cost of Maintenance, more the cost less will be preference to buy as all the consumers tries to look for cheaper alternatives having low cost and requirement of maintenance. That is why while ranking the filter configuration with respect to the cost of procurement and maintenance more the cost of the configuration less rank was awarded. The configurations were sorted in such a manner that the costliest configuration received the worst rank or preference.
- For Number of Stages criteria, as more the number of stages more contaminant can be removed. That is why more the number of stagers higher rank of preference was awarded to the configuration
- For Contaminant Removal Efficiency, more the removal efficiency of the configuration more preference will be given and thus highest rank of preference was awarded to the configuration which have maximum contaminant removal efficiency.

# How to find the best filter configuration by Simple Decision Maker Webware ?

- When the link is opened the Home page will delineate the procedure to be followed. First of all convert the ranks to “Complement of Normalized Rank” by following the instruction in the home page of the software.
- For the present example, we have four alternatives. So rank assigned to the alternatives will be converted to its normalized rank by :

$$\frac{x}{4+1}$$

where x is the rank assigned to the alternative.

and Complement of Normalized Rank will be calculated by :

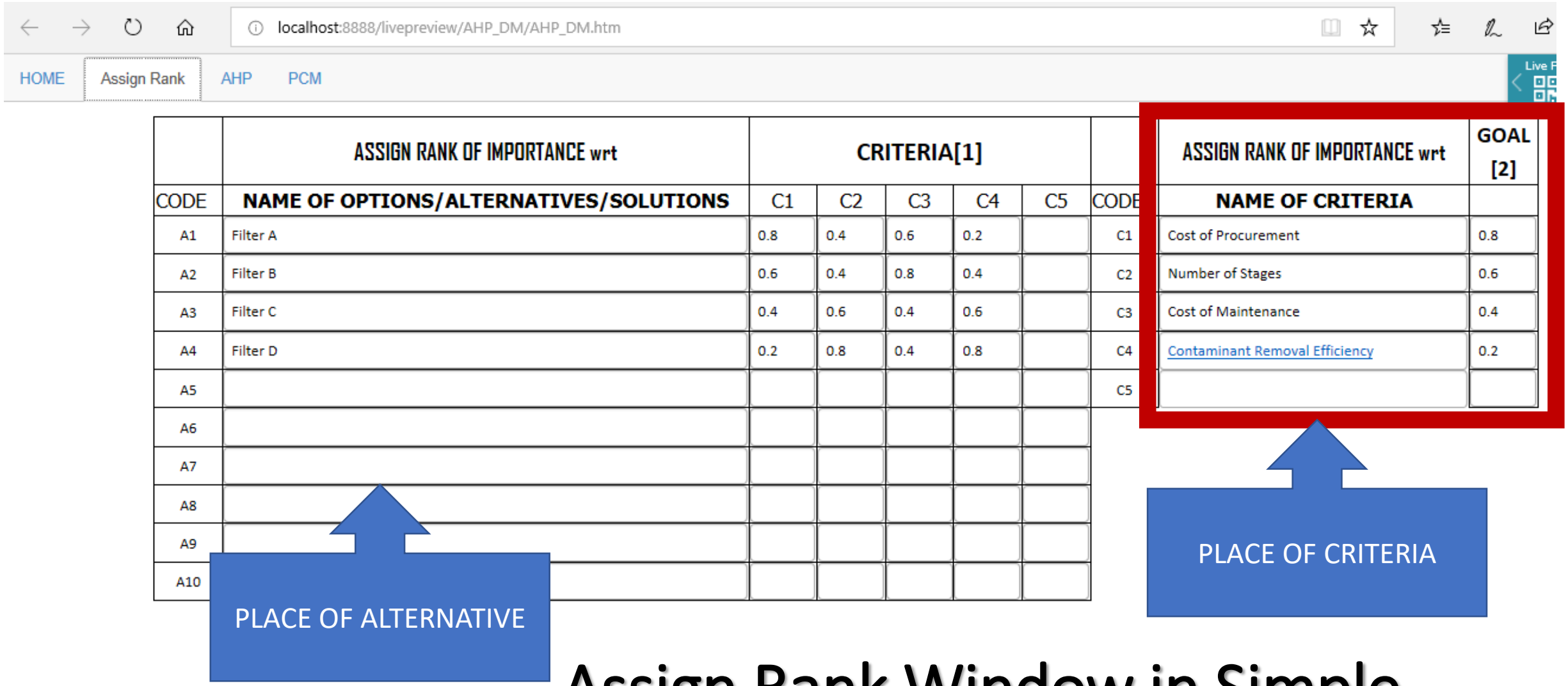
$$\left\{1 - \frac{x}{4+1}\right\}$$

# Complement to Normalized Rank

| Name of Filter Configurations* | Cost of procurement (INR) /Rank | Number of Stages /Rank | | Cost of Maintenance /Rank | | Contaminant Removal Efficiency (%) /Rank |
|---|---|---|---|---|---|---|
| Filter A | 0.8 | Activated Carbon | 0.4 | 100 | 0.6 | 0.2 |
| Filter B | 0.6 | Activated Carbon + UV Light | 0.4 | 125 | 0.8 | 0.4 |
| Filter C | 0.4 | Activated Carbon + Ion Exchange + UV Light | 0.6 | 250 | 0.4 | 0.6 |
| Filter D | 0.2 | Activated Carbon + Reverse Osmosis + UV Light | 0.8 | 500 | 0.4 | 0.8 |

# Assigning Rank of Preference to the Criteria

- Now a Complement to Normalized Rank of Preference to the Criteria is required to be assigned.
- For this example : Contaminant Removal Efficiency(CRE) will be the most important criteria followed by Cost of Maintenance(M), Cost of Procurement(P) and lastly the Number of Stages(S)(See Slide 10).
- Accordingly the Complement to Normalized Rank of Preference was calculated and found to be equal to
- CRE : 0.8 > M : 0.6 > P : 0.4 > S : 0.2.
- After these values were entered in the place of Criteria go to AHP page to find the results.
- For this example Filter A becomes the best filter due to very low cost of maintenance and procurement. Filter D, although it has the best CRE but due to high cost of procurement and maintenance it become the least preferred alternative.




# Assign Rank Window in Simple Decision Maker

| RESULT FROM AHP | | |
|---|---|---|
| | **OPTIONS/ALTERNATIVES/SOLUTIONS** | **RANK OF DOMINANCE [1]** |
| A1 | Filter A | 1 |
| A2 | Filter B | 2 |
| A3 | Filter C | 4 |
| A4 | Filter D | 3 |
| A5 | | |
| A6 | | |
| A7 | | |
| A8 | | |
| A9 | | |
| A10 | | |

PLACE OF RESULT



# AHP window of Simple Decision Maker Webware

# Thank you

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