



Summer Internship Project Report

Indigenization, Production and modification in Mechanical Design Of Disinfectant Dispenser

Submitted by

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Acknowledgement

The internship opportunity I had with Forbes Marshall introduced me to several opportunities of learning various technical things and skill development. I consider myself very lucky to have been provided with this chance to meet so many people who not only helped me gain technical insight but also helped me grow professionally.

I would like to express my sincere gratitude to my project guide Mr. Yogesh Gothe for having faith in me, showing me the right direction and for providing the invaluable guidance, comments and suggestions during the completion of my project given in the course of two months of internship. I choose this moment to not only acknowledge but also deeply thank him for his valuable contribution to my internship project, in spite of being busy with his own duties and schedules.

I would also like to thank HOD of my college respected Ashok Mache Sir and Atul Kulkarni Sir for providing me with the allowance for the internship which has helped me to develop the industrial knowledge and have a valuable experience and gain practical knowledge.

I will truthfully try to make full use of the skills I have learned and sharpened in Forbes Marshall and apply the knowledge as required. I will always be highly obliged to everyone who helped me throughout my internship at this esteemed organization and I wish to take this opportunity to thank each one of those.

Sincerely,

Soham Patil.

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1) Objective:

To indigenize and modify the mechanical design of the machine and convert it into the format that can be directly supplied to the vendors for further production.

2) Introduction:

About Forbes Marshall:

Forbes Marshall is a leading name in the process industry providing process efficiency and energy conservation along with automation solutions. Started as J.N. Marshall & Co. the company ventured into trade concerning steam accessories. Further, Marshall progressed into the sale of packaged boilers eventually their first own manufacturing unit was built in Kasarwadi, Pune. As manufacturing of steam system products was introduced, FM entered control instrumentation business. As Forbes Marshall accelerated their growth in the control systems' equipment manufacturing, they introduced consultancy services for layout and detailed engineering of new process plants. With several international collaborations and efficient and innovative working strategy, Forbes Marshall has reached the summit of success from where only the sky's the limit.

It was not only a pleasure but also a huge honor to have worked with an esteemed organization like Forbes Marshall. The vision and values of the company which include, Family Spirit, Integrity, Innovation and Entrepreneurship and Delivering Value resonate with my principles and mottos, which further motivated me to constructively utilize the opportunity that I was provided with. Forbes Marshall is also widely recognized and acclaimed as one of the best workplaces and a true engineering company.

The training facilities provided by Forbes Marshall are focused on capacity building and knowledge enhancement of the student i.e. the trainee. With the vast learning culture that existed in the company, as an intern, I felt more driven to imbibe all the knowledge that was being provided. Not only was I provided with informative literature to study but my project guide along with my supervisor and other employees helped me out with various doubts and problems, both big and small. The Following project is a bit different than the previous projects, which is related to cleaning and disinfecting the

surroundings. For this purpose, a new company was incorporated – **Swiss NeWater India pvt. Ltd.** In June 2019.

3) Disinfectant Dispenser- Swiss NeWater:

The present SNW machine has been built to accommodate an array of 18 individual solutions. A standard range of six solutions has been installed by default in the machine, (however some of the test machines are as of now offering only four combinations with option of adding two more):

1. light disinfection / spray 40 ppm (rooms);
2. heavier disinfection / spray 150 ppm (blood, toilets),
3. maximum disinfection / flask 500 – 1.000 ppm (intense usage to be tested),
4. cleaning & slightly degreasing / spray PH 8.5 (glass),
5. disinfection & degreasing / spray 150 ppm & PH 10.5 (kitchen),
6. heavy degreasing / high concentration (floor-cleaning, scrubber dryer machine).

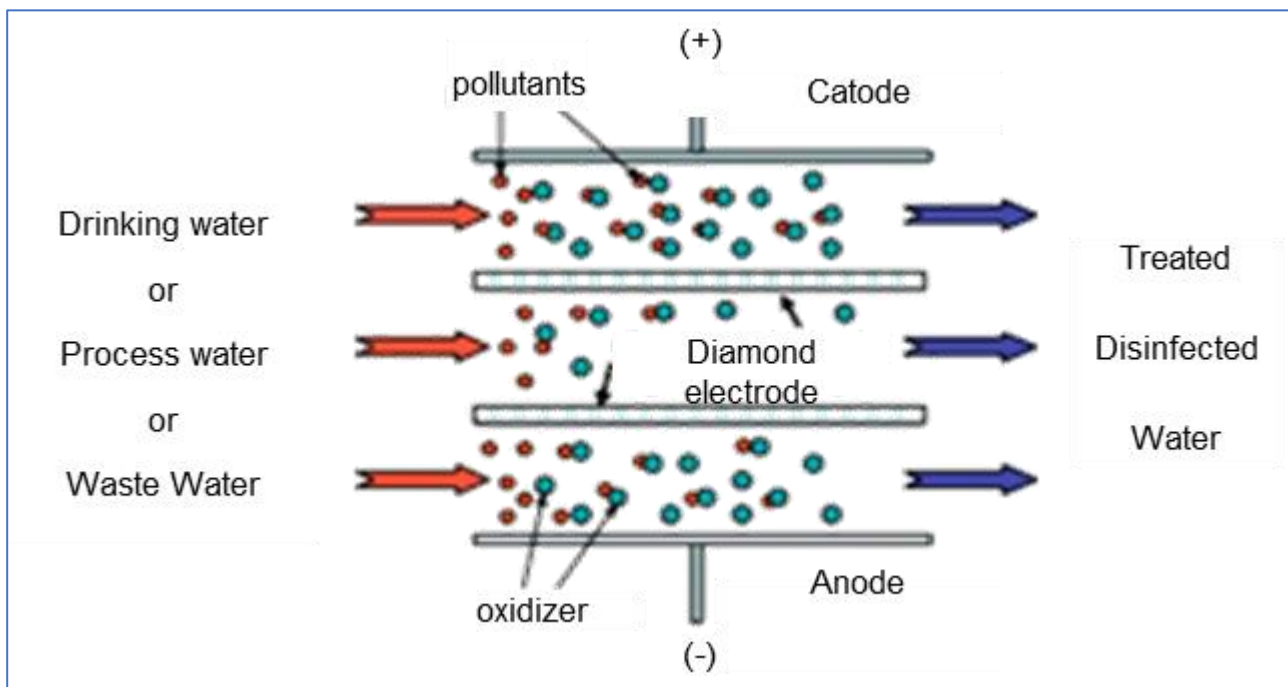
3.1) Science behind the Product:

The technology is based on the principle of electrolysis of water and minute control of the process so as to obtain the precise products of electrolysis as per requirement. The product is a result of the electrochemical reaction of water and salt, when a certain electrical impulse is given through a unique state-of-the-art electrode. The chemical reaction is controlled through the machine software so as deliver the precise requirement.

While the basic technology of electrolysis of water has been in existence since many years, the catch was how to master it and improve on the technique so as to achieve the correct and requisite balance of all relevant factors. The role played by the special electrode, the software and other special factors of the machine are the main contributing factors to obtaining the required products.

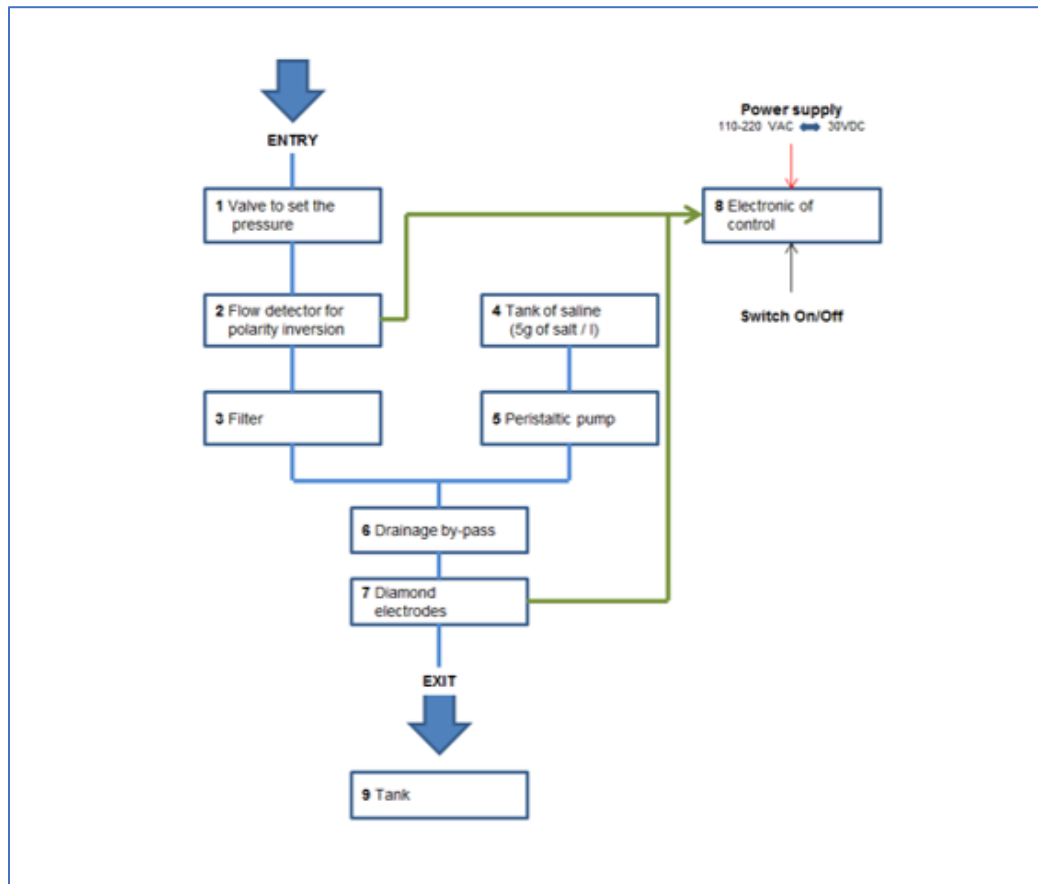
Through the electrolysis process, the water molecule breaks down into parts, and thereafter recombine in a variety of new components, generating powerful oxidants and also some other elements such as chlorine, etc. which are associated with the electrolysis of water. Their combined effect constitutes a very effective disinfectant capable of neutralizing bacteria, viruses, spores, algae and other germs. After the utilization of the HydroClean solution, it undergoes another chemical reaction, tending to normalize again, with plain water and a bit of salt as the main residue elements; hence causing a virtually nil impact on the environment.

Given below is the pictorial representation of the science which is used in the machine:



3.2) Technology:

a. Flowchart of the machine



This machine is composed mainly of nine parts:

The concept of such a machine appears to be pretty straightforward. But the interaction between the electrode, the electronic component and the salt delivery device makes it more complex. And a rather sophisticated process is needed to manufacture it in an optimal way at an industrial scale for a minimized price. An additional option has been conceived to fill directly floor scrubber-dryers and hold higher stocks of additives.

b. Machine model

It is important to ensure that at least four criteria are met:

- Ease of use (many SNW users want simplicity)

- Simple maintenance (for example the water purifier filter)
- Robustness / safety (water and electricity must co-exist without risk)
- Good water shelf life (plastic container / no metal. No light)

The machine is able to produce several recipes and enabling the user to choose the solution according to the anticipated usage.

In addition, there is a plan to produce machine that could:

- Be remotely controlled
- Produce bigger quantities



The machine is either fixed on the wall or installed on a table. The dimensions in cm are 50 width x 65 depth x 100 height. Weight is 40 kg empty and 70 kg when the machine is full.

c. Properties of the product

The actual version of the machine can be customized to propose proprietary or tailor-made recipes. Depending on the needs of users the machine will propose one or several recipes.

The recipes are a combination of diluted electrolyzed water and a mixture of additives. This allows to reach different levels of disinfection, degreasing power, etc.

The SNW machine has been built to accommodate an array of 18 individual programs. A standard range of six products has been installed by default in the machine:

- a) light disinfection / spray 40-50 ppm (rooms and lobbies);
- b) heavier disinfection / spray 150 ppm (blood, toilets, kitchen)
- c) maximum disinfection / flask 500 – 1.000 ppm and also
- d) cleaning & slightly degreasing / spray PH 8.5 (glass, windows)
- e) disinfection & degreasing / spray 150 ppm & PH 10.5 (kitchen, working tables)
- f) heavy degreasing / high concentration (floor-cleaning scrubber dryer vehicles). However, our Swiss NeWater machine can be customized for each client, considering their specific needs, as well as their desired balance regarding specialization versus ease-of-use.

One example of recipe table is as follows:



Disinfectants:

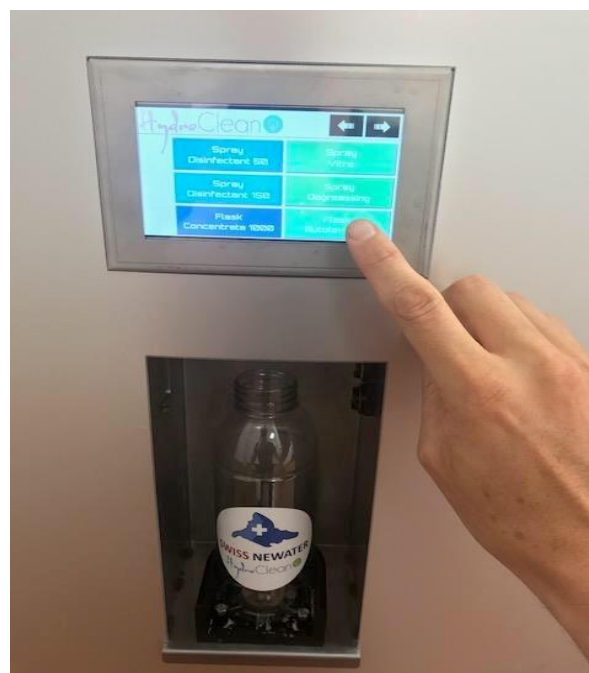
1. Spray Disinfectant 50: clean rooms and lobbies
2. Spray Disinfectant 150: clean toilets and kitchens
3. Flask concentrate 1000: clean intense usage

Degreasing:

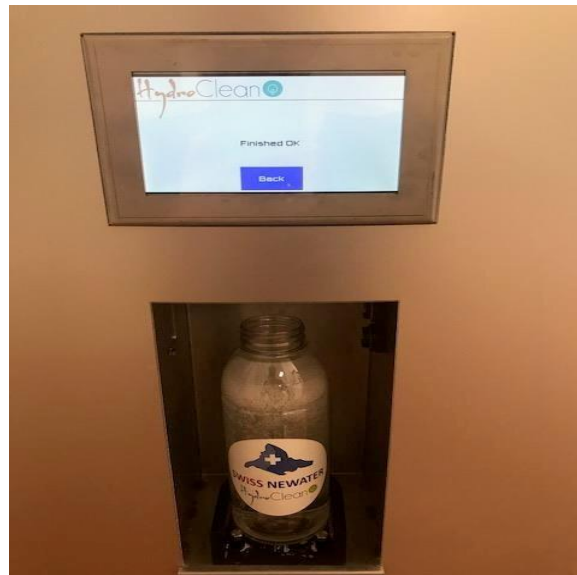
1. Spray “Glass”: clean windows
2. Spray “Degreasing”: degrease table, rooms and kitchens
3. Flask: used in scrubber dryer machine

d. Use of the Machine

The user will have to place a flask or a spray in the machine and press the button recipes in order to fill the container:



Once the container (flask/spray) is full, the user can get the product that is ready to use



3.3) Concept

As one has been aware the major cause of illness has been the penetration of undesirable bacteria or germs into our body system through external medium. There is a constant effort to reduce the influx of such harmful bacteria at various levels.

An extreme example is the disinfection that is necessary prior and post carrying out of any surgical procedure in the hospital. Hospital acquired infection is a bane that most hospital are continuously fighting against without making much mention of the same. The need to disinfectant the flooring or the other surfaces that are subjected to public exposure is often not given its due.

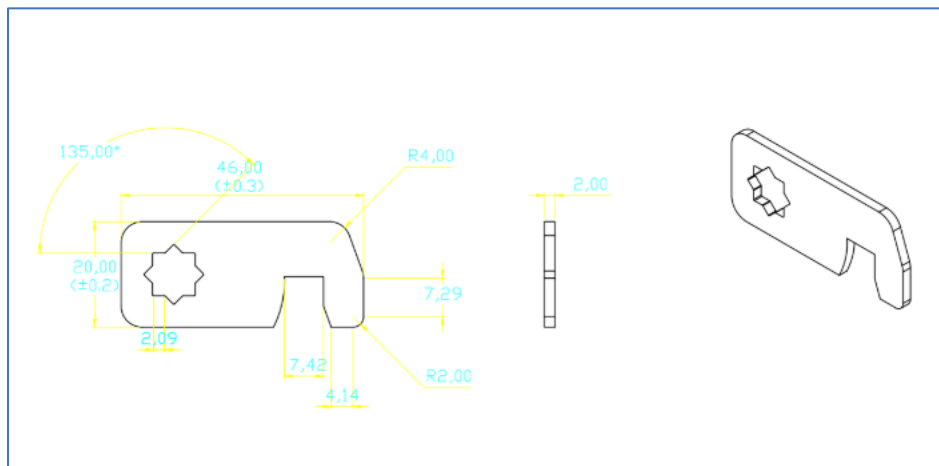
The main concept of Swiss NeWater is the electrolysis of the brine water which converts it into a Disinfectant solution and then is Dispensed according to the requirement and is diluted to the required concentration. Two additional features are added for fragrance and degreasing which are added in with the help of additives

4) Mechanical Design:

The Drawings of the parts were originally in SOLIDWORKS software and consisted of total 10 assemblies including major assemblies like frame, BDD, Door, etc. All the parts which added up to the total assemblies and were produced by sheet metal processing like sheet metal cutting and bending. The material used for the frame was Aluminium and that for the internal parts were made of SS.

4.1) Overview of Drawings:

The main characteristics of the Drawings were the presence of iso metric view in the Scalar diagram itself which added to the visualizations of the part. For more clarification let's see an example of a part of door



Every drawing was in different scales which was not suitable for the basic production method which was laser cutting. For the same purpose the required scale was 1:1 but was not present in the given drawings. So, this was the first task that was performed – changing the scale of drawing to 1:1 for laser cutting purposes.

Moreover, the dimensions of the drawings were missing so it were added for the purpose of mechanical checking after that particular part was done manufacturing. It was then put in a particular frame and notes were added to it regarding the manufacturing processes and minor details like the diameter of the bolts, etc. Finally, the count of the part and the quantity of the hardware used in it was mentioned. Following this the location of the part in the machine was also mentioned on the upper side of the

drawing and its purpose was also stated. The material in which the part was to be produced was also mentioned with the thickness of the same.

4.2) Change in format:

The basic problem raised was that the drawings accepted by the vendor were in Autocad software, but we had it in the SLDPRT format which is a solidworks drawing. So, the task following the overall changes which were mentioned in the upper section was to convert each drawing into DWG format which is an autocad file. For the same I had to be very careful about the scale of the drawing as it had to stay in the scale 1:1 even after conversion. The dimension lines and the part were then given different colours for better understanding and recognition

4.3) DIN and ISO standards:

The next problem which was faced was the difference in the standards of the drawings which could affect the assembly of the machine.

Product standards		Product standards	
DIN	ISO DIN ISO DIN EN ISO	DIN	ISO DIN ISO DIN EN ISO
1	2339	830*	-
7	2338	835	-
39	-	906-910	-
84	1207	911	2936
85	1580	912 (RG)	4762
		912 (FG)	12474
93*	-		
94	1234	913	4026
95, 96, 97	-	914	4027
98, 99	-	915	4028
123, 124	1051	916	4029
		917	-
125 -1, 2	7089, 7090		
126	7091	920-927	-
127*, 128*	-	928, 929	-
134*, 137*	-	931 -1	4014
186, 188	-	931 -2	-
		933	4017
258	ISO 8737		
261	-	934 RG	4032, 4033
302	1051	934 FG	8673, 8674
314-318	-	935 -1	-
319	-	935 -3	-
		936 RG/FG	4035 / 8675

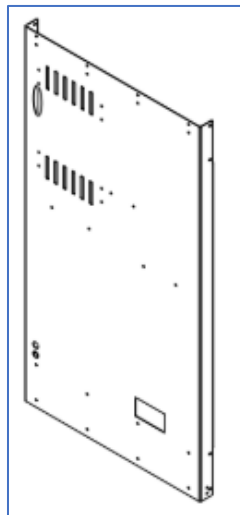
Given above is a part of the table which was used for conversion of the standards. In addition to the conversion the tolerances were added to the dimensions for the manufacturing purposes according to the ISO standards.

Class of Tolerance	Limits (mm) for nominal sizes (mm)							
	0.5 up to 3	exceeding 3 up to 6	exceeding 6 up to 30	exceeding 30 up to 120	exceeding 120 up to 400	exceeding 400 up to 1000	exceeding 1000 up to 2000	exceeding 2000 up to 4000
f (fine)	± 0.05	± 0.05	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	-
m (medium)	± 0.1	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2
c (coarse)	± 0.15	± 0.2	± 0.5	± 0.8	± 1.2	± 2	± 3	± 4
v (very coarse)	-	± 0.5	± 1	± 1.5	± 2.5	± 4	± 6	± 8

The above shown table shows some of the tolerances which were added to the metric dimensions in the drawing. The tolerances were also added to the bending angles in the drawing. After the calculations the tolerances were added on the drawing. And finally, the drawings were converted into pdf format for easy checking and for reference purpose.

5) Center of Gravity:

The Left and Right panels of the machine consist of handles for lifting the machine. In the latest version of the machine design it was observed that the handles were not placed on the center of gravity which would have created difficulties in lifting up the machine. Solution for this was the shifting of the center of gravity. For the same, firstly the weight of the whole system was approximately calculated and with the help of SOLIDWORKS software the exact center was calculated, and the handles and the cavity was shifted to the points. The precautions that were considered were that the handles should not coincide with other system parts like the support frames which were approximately situated in the same region. The support plates added to the firmness of the handles, as the handles were placed in between them



Above shown is the example of the panel drawing with the cavity for the handles for lifting the machine. As you can see in the above drawing the handle position clearly is nowhere near the center, so it had to be shifted there.

6) Principle

The scientific principle of the machine is majorly based on the electrolysis of the brine water through the BDD- Boron Doped Diamond Electrode which will be briefly discussed in this section.

6.1) Electrolysis:

In chemistry and manufacturing, **electrolysis** is a technique that uses a direct electric current (DC) to drive an otherwise non-spontaneous chemical reaction. The voltage that is needed for electrolysis to occur is called the decomposition potential. The key process of electrolysis is the interchange of atoms and ions by the removal or addition of electrons from the external circuit. The desired products of electrolysis are often in a different physical state from the electrolyte and can be removed by some physical processes. For example, in the electrolysis of brine to produce hydrogen and chlorine, the products are gaseous. These gaseous products bubble from the electrolyte and are collected.



A liquid containing electrolyte is produced by:

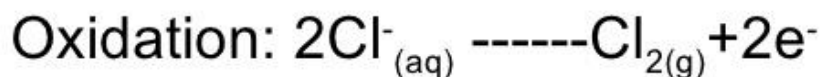
Solvation or reaction of an ionic compound with a solvent (such as water) to produce mobile ions

An electrical potential is applied across a pair of electrodes immersed in the electrolyte.

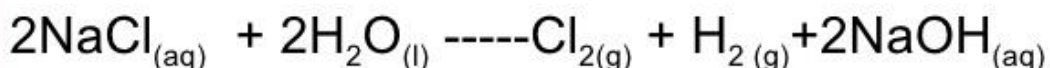
Each electrode attracts ions that are of the opposite charge. Positively charged ions (cations) move towards the electron-providing (negative) cathode. Negatively charged ions (anions) move towards the electron-extracting (positive) anode. In this process electrons are either absorbed or released. Neutral atoms gain or lose electrons and become charged ions that then pass into the electrolyte. The formation of uncharged atoms from ions is called discharging. When an ion gains or loses enough electrons to become uncharged (neutral) atoms, the newly formed atoms separate from the electrolyte.

Electrolysis of Brine

At Anode (+ electrode)



Overall Reaction:

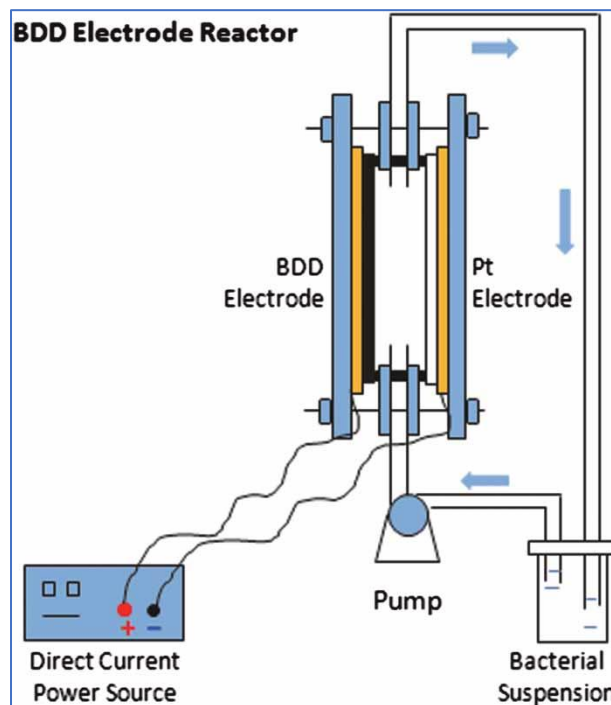


The chlorine is collected and used as disinfectants
Hydrogen can be collected, and NaOH can also be recovered and used

As mentioned above the chlorine is collected and used as a disinfectant. In addition to the chlorine certain additives are added to enhance the performance of the disinfectant.

6.2) BDD: Boron Doped Diamond Electrode

This is a special type of electrode used in the machine for electrolysis purpose. Because Boron-doped diamond (BDD) is an excellent electrode material with superior material characteristics. BDD has the largest electrochemical potential window in aqueous solutions compared to traditional electrode materials such as gold, platinum and glassy carbon. Chemical reactions that occur within the electric potential range from -1.2 V to +2.5 V can be investigated. BDD has a characteristically low and featureless background current resulting in higher sensitivity and improved detection limits. In addition, the material also features extreme chemical stability, which makes BDD electrodes last longer in aggressive environments. BDD is optically transparent, mechanical robust and biocompatible. The electrode consists of three plates, the brine water passes between these plates and gets electrolyzed



The image above summarizes the process carried out in the BDD electrode.

7) Operation:

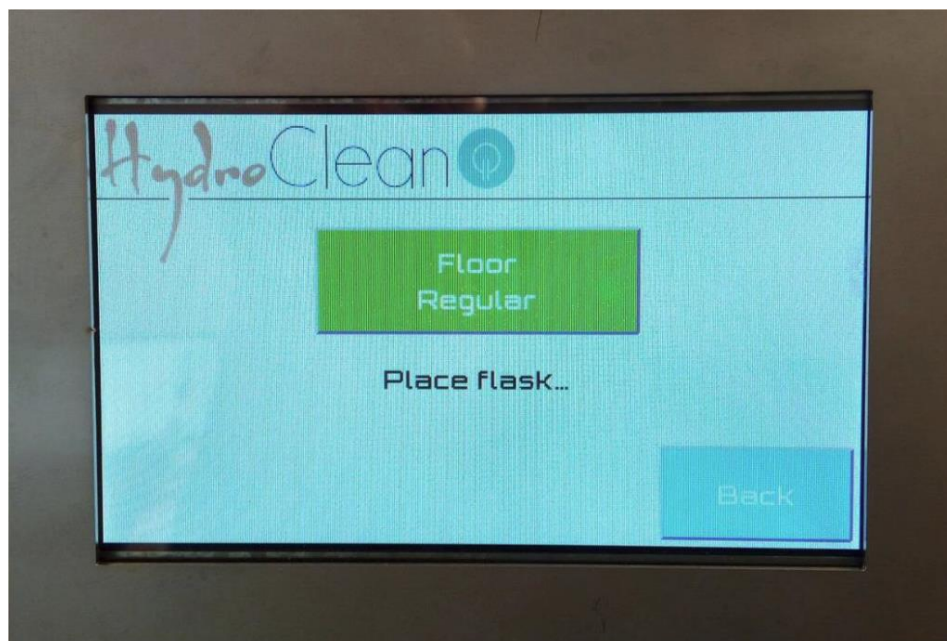
The installation and operation of the machine is designed to be such that it is extremely user friendly. The operation can be done by any unskilled person as it merely involves very simple tasks that anyone performs in day to day activity. It simply involves placing of a bottle in the designated slot, pressing of the appropriate touch screen at the matching button and collecting the bottle when full. Thereafter one caps the bottle and uses its contents as desired. In case a larger quantity is desired, the operation can be repeated as required.

The purpose of making the process simple is that the machine should be such that it can be operated by the worker himself/herself who is going to personally use the cleaning solution physically. The operation of the machine once installed is simple and elementary. There are three switches involved which in normal circumstances would remain On at all times. These are the Main Switch supplying power to the machine which would be located as per provision by the customer; the Net Entry Switch located on the top of the machine at the rear right end; and the Machine Operation Switch also located

on the top of the machine but at the front right side. The liquid dispensing and bottle holding niche is at the front center of the machine door above which is the display screen. The user has to select the screen which shows the “Recipes” available.



Then select the desired disinfectant and press the screen on that selection.



The screen will prompt the user to place the flask at the dispensing niche and then press START, wherein after the selected concoction will automatically fill the bottle to the calibrated quantity. The bottles provided with machine are specially designed so as permit easy placement and facilitate visual indication of the liquid once it is being filled.

8) Applications:

The Hydroclean SNW machine has the capability of preparing up to 18 different pre-programmed concoctions for different disinfectants. The versatility in its products gives it the capability to manufacture disinfectant for a wide range of applications by a single machine placed within an establishment. Its properties cover almost the entire scope within the regular daily usage of our lives.

These can be used for a range of purposes for surface cleaning at locations including

1. Floors, slabs, walls etc. offices, hotels, hospitals, residential rooms etc.
2. Pantries, kitchens.
3. Washrooms, toilets, bathing areas of all locations.
4. Laundries.
5. Storerooms including those for Hazmat storage.
6. ICUs, OTs, Laboratories, etc.

As a disinfectant, one can consider utilizing the same for cleaning of vegetables and other consumables that require disinfection prior to usage. The present machines have been pre-programmed to deliver six basic products, which can be enhanced as per the customer's requirement. The existing programmes cater for the main usages in hospitals, hotels & restaurants. These programmes cover a range of applications, from medical disinfection to kitchen degreasing. More specific functionalities can be programed on demand, depending on the individual needs of each user.

A standard range of four/six solutions (depending on the model) installed at present in the machine by defaults as under:

Light disinfection / spray used for room surfaces (40 ppm).

Heavier disinfection / spray used for toilets, washrooms, ICUs etc. (150 ppm).

Heavy disinfection / flask used for labs, OTs (500 – 1000 ppm).

Glass and tabletop cleaning & slightly degreasing / spray (with PH 8.5).

Disinfection & degreasing / spray 150 ppm (with PH 10.5).

Heavy degreasing / high concentration for bulk cleaning operations (floor-cleaning through scrubber dryer machine).

Each customer may like to obtain a custom-made requirement that suits the operational purpose in a functional and economically optimal manner which is then provided with due consultation.

9) Advantages:

The Hydro clean is a revolutionary concept and provides a simple and unique solution to making affordable, very effective, safe and a range of disinfectants by manufacturing the same locally within one's own complex without having to establish a manufacturing unit.

1. The machine is compact like household refrigerator, consuming only water, pure salt, electricity and additives as required.
2. Very limited skill is required to operate the machine.
3. The machine is versatile and requisite disinfectant can be produced in quantity on an "As-Required" basis each time within seconds, thereby eliminating wastage.
4. The product is eco-friendly, very safe and convenient to use.

5. The cost of the product works out to be a mere fraction of that of the existing equivalents in the market.

About the Machine

6. The manufacturing unit is compact and occupies minimal space less than a domestic refrigerator.
7. It requires approximately 650mm by 500 mm of space with a height of just over one meter in normal ventilated environment.
8. It requires only a water connection and a regular domestic electrical socket.
9. It is user friendly and can be operated by unskilled personnel.
10. The machine facilitates production of the product in small measured quantities, thus eliminating the need for storage and stocking. This also cuts costs to a very large extent.
11. It can be wall mounted or on a platform.
12. It requires minimal maintenance and only regular routine external cleaning.

About the Process and Product

13. Being basically a combination of pure salt and water, the product is eco-friendly and very safe to use.
14. It serves a dual purpose of being both a disinfectant and a cleansing agent simultaneously.
15. The cost of the product is a fraction of any equivalent that is prevalent at present in the industry. This alone makes it a revolutionary item that will change the way the populace looks at disinfection and cleaning agents.

16. The Return on Investment can be recovered within a short period depending on the quantity of and type of disinfectant solution being used. In normal course it could vary between 12 to 24 months for a hospital / hotel.
17. Can be modified to large extent so as to serve and suit the purpose as required by the customer. Thus also, the concentration can also be optimized to reduce the cost of consumption to minimal level as determined by the customer.
18. Different products can be obtained from one single unit. This eases the procurement of various cleaning items from just a single point and in the quantity as required.

The advantages of such an arrangement are immense.

10) Future Scope:

The initial design of the machine has the capacity of 40 L and the external tank can be up to 100 L. This arrangement is useful for small scale product usages, but the future scope is to scale up the machine for bigger usage such as in the malls and hospitals having greater requirement. For the scaling up each and every parameter needs to be checked and modified according to the need. Also, the aesthetics of the machine can be improved for public appeal. Further the Disinfectant can be used for CIP- Clean in place in industries for appropriate cleaning processes.

11) Conclusion:

The Modification and Indegenization of the Disinfectant Dispenser was done with the tools like- Solidworks and Autocad, with the development of vendor relations and ordering process, and the management of drawings in various formats accepted and understood by Indian Vendors- (corresponding to Indian Standards) assisted by the thorough study of the machine supported by troubleshooting due to appearance various errors while studying and hence solving them.