

## AN EXPERIMENTAL STUDY TO EVALUATE THE EFFICACY OF SPHATIKA IN THE PURIFICATION OF CONTAMINATED WATER W.S.R TO QUARTZ.

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## ABSTRACT

Water being the most essential and basic of life; it must be pure and free from any contaminants. Polluted water is main reason for waterborne diseases. Considering this, an experiment has conducted to study the efficacy of quartz in the purification of contaminated water which is simple and easy. **Aims and Objectives:** To carry out the experiment using *Sphatika* (Quartz) to evaluate its efficacy in the purification of contaminated water. **Methodology:** The water sample was taken in a glass bottle of 500ml; 1st group was used without any materials. Second group was subjected to filtration. Third group was added with *Sphatika* (quartz) in the quantity of 10, 25 and 50 grams. Each of the samples was assessed after 6, 12 and 24 hrs: for the physical, chemical and microbial parameters. **Results:** Quartz reduces Salinity, Total Hardness (TH) and Magnesium; and increases pH, Conductivity, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Total Alkalinity (TA), Carbonate and Bicarbonate. While there was no change in Calcium. After adding of quartz, the microbial colony count further increased. **Conclu-**

**sion:** Quartz showed positive results in some of the parameters. It doesn't possess an antibacterial effect. It can be used as a medium in filters.

**Key words:** Water; *Sphatika*; Quartz; Contaminated water

## INTRODUCTION

Water is a precious and vital natural resource which forms the basis of all life. It is one of the marvelous gift to mankind from nature. It is very essential factor in the life of an individual both directly and indirectly. In Ayurveda, *Jala* (water) is considered as one of the *Panchamahabhoota*. The ancient literatures highlighted the importance of water along with its properties. Water is considered as base of *jivana* that is life, is compared to nectar and *pathya* which is conducive and acceptable for all the living beings. It also acts as rejuvenating, satiating, and good for heart, pacify exertion, fatigue, thirst, drowsiness, sleepiness, burning and is wholesome<sup>[1]</sup>. Water covers about 71% of the earth's surface but only 1.7% is available as surface water<sup>[2]</sup>. There is different source of water. As the source changes the quality of water also differs. Globally, at least 2 billion people use a drinking water source contaminated with feces and other harmful materials<sup>[3]</sup>. The water pollution (both natural and man-made) makes the water contaminated and intake of such water leads to various water borne diseases. In Ayurvedic classics, water impurities are mentioned as one of the causes of *Janapadodhwamsavyadhi*<sup>[4]</sup>. It affects large group of people or community at a time. The main cause for *Janapadodhwamsais* said to be *Adharma* (unrighteousness) done by humans, which arise from the sinful acts done in both past and this life, but the source for both is *Pragnaparadha* (intellectual blasphemy)<sup>[5]</sup>. The water when vitiated or polluted will cause various serious ailments like vomiting, intoxication, fever, burning sensation, inflammation, diarrhoea, etc.<sup>[6]</sup>. To overcome the harmful effect of contaminated water various techniques and methods have been adopted nowadays like filters, chemical agents, purifiers, reverse osmosis, etc. Ancient Acharyas also described various methods and materials which can be used even today with some modifications like

boiling, dipping of red-hot iron ball, using cloth as a medium for filtration, exposure to sunrays and moon-rays, using *Nagakesara*, flowers of *Campaka*, *Utpala*, *Patala*, etc. to remove bad odor<sup>[7]</sup>. *Acharya Sushruta* has mentioned seven materials to be used for purification of *Kalusha Jala* (polluted water). They are *Kataka* (*Strychnospotatorum*), *Gomeda* (gemstone), *Bisagranthi* (lotus root), *Shaivala moola* (*Ceratophyllum demersum*), *Vastra* (cloth), *Mukta* (pearl), and *Mani*<sup>[8]</sup>. For *Mani*, *Acharya Dalhana* commented as *Sphatika*. When we go through various *Rasasastra* books we get the reference of *Sphatika* under *Uparasa* as third mineral drug i.e Potash alum as well as under *Uparatna* as Quartz. Here for this study quartz has been selected. Hence, to provide essential data and proper validation, a study was conducted to evaluate the efficacy of *Sphatika* (quartz) in the purification of contaminated water, which is affordable, simple and easy to conduct and can be effectively used even today with very minimum equipment's and technology.

## MATERIALS AND METHODS:

The experiment was taken to study the efficacy of *Sphatika* (quartz) in the purification of contaminated water, mentioned in *SushrutaSamhita*. The procedure of purification, vessel to be used, and quantity of drugs to be used in certain amount of water and time period were unknown. So, before conducting the experiment, all these factors had analyzed, and a new experiment protocol had designed by considering all the factors. *Sphatika* (quartz) was immersed in the water sample and had observed the changes seen in the various parameters of water.

Sample (raw water) was collected in the month of September from an unused, polluted well which had the turbidity between 2-5 NTU. Water treated with Chemical purifying agents and from other sources like tap, river, lake water, etc. was excluded for the

study. Quartz was collected from an authentic source. For the experiment, Glass bottle was used as it is inert and won't react with the substances used in an experiment. The quantity of quartz was taken as 10, 25 and 50 grams and time for immersing was considered as 6, 12 and 24 hrs for each 10, 25 and 50 grams. 500 ml of water sample was considered for the experiment.

**Design of Study:**

Each water sample had taken in a sterile glass bottle and labelled as group A, group B and group C and kept in a normal room temperature inside the building where direct sunlight and wind would not reach the glass vessels.

Grouping: Total three groups were made for the study.

- A. **Control group:** Water sample collected from the source (well) without any treatment materials and methods.
- B. **Standard group:** Water sample collected from the source (well) had subjected to filtration using standard filter. The filtration instrument used in this study was KENT, UF membrane water filter.
- C. **Test group:** Quartz was added to the collected water sample (well).

Test group C was further divided into following groups:

- 10 grams each for 6, 12 and 24 hours

- 25 grams each for 6, 12 and 24 hours
- 50 grams each for 6, 12 and 24 hours

Later the samples had subjected for analysis separately for below mentioned parameters as prescribed by Bureau of Indian Standards 2020.

**Parameters investigated are:**

- **Physical Parameters:** Color, Odor, Conductivity, Salinity, Turbidity, pH, Total Dissolved Solids (TDS), Dissolved Oxygen (DO)
- **Chemical Parameters:** Total Hardness, Total Alkalinity, Calcium, Magnesium, Carbonates, Bicarbonates
- **Microbial Load Analysis:** Bacterial colony count

**OBSERVATIONS AND RESULTS:**

*Sphatika* (Quartz) was the drug taken for the study. There was total three groups in the study. They are: - Group 'A' - Control group (untreated water / raw water), Group 'B' - Standard group (Filtered water) and Group 'C' - Test group (well water added with quartz). There was total 9 samples for group C. 3 each for adding of quartz in the quantity of 10, 25 and 50 grams for the time period of 6, 12 and 24 hours respectively. After the desired time period, each sample was analyzed for physical, chemical and microbiological parameters.

Table No.1 showing physico – chemical test results of Group A (untreated water) and Group B (filtered water)

Sl. No.	Parameters	Group A (Untreated water)	Group B (Filtered water)	BIS: 10500-1993 Standards
1	Colour, Hazen Units	Clear	Clear	Colourless
2	Odour	Agreeable	Agreeable	Agreeable
3	pH	6.78	5.27	6.50-8.50
4	Conductivity $\mu$ S (Micro Siemens)	<b>122</b>	<b>46.8</b>	NS
5	Total Dissolved Solids (mg/L)	<b>70.9</b>	<b>29.5</b>	500
6	Salinity	0.02	0.02	NS
7	Turbidity (NTU)	<b>3.0</b>	<b>1.0</b>	05
8	Dissolved Oxygen	<b>7.2</b>	<b>7.8</b>	NS
9	Calcium (mg/L)	4.0	4.0	75
10	Magnesium (mg/L)	4.86	4.86	30
11	Total Hardness (mg/L)	30.0	30.0	300
12	Total Alkalinity (mg/L)	18.0	18.0	200
13	Carbonates (mg/L)	10.8	10.8	NS
14	Bicarbonates (mg/L)	7.2	7.2	NS

Table No.2 showing physico – chemical test results of Group C (well water after 6 hrs of adding 10gms, 25gms and 50gms of quartz)

SI.No.	Parameters	6hrs (10gms)	6hrs (25gms)	6hrs (50gms)	BIS: 10500-1993 Standards
1	Colour, Hazen Units	Clear	Clear	Clear	Colourless
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable
3	pH	6.92	5.92	5.76	6.50-8.50
4	Conductivity $\mu$ S (Micro Siemens)	<b>129</b>	<b>134</b>	<b>137</b>	NS
5	Total Dissolved Solids (mg/L)	<b>70.9</b>	<b>71.3</b>	<b>72.4</b>	500
6	Salinity	0.02	0.02	0.02	NS
7	Turbidity (NTU)	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	05
8	Dissolved Oxygen	<b>8.6</b>	<b>8.8</b>	<b>8.9</b>	NS
9	Calcium (mg/L)	4.0	8.0	4.0	75
10	Magnesium (mg/L)	2.43	2.43	2.43	30
11	Total Hardness (mg/L)	20.0	30.0	20.0	300
12	Total Alkalinity (mg/L)	22.0	18.0	18.0	200
13	Carbonates (mg/L)	13.2	10.8	10.8	NS
14	Bicarbonates (mg/L)	8.8	7.2	7.2	NS

Table No.3 showing physico – chemical test results of Group C (well water after 12 hrs of adding 10gms, 25gms and 50gms of quartz)

SI.No.	Parameters	12hrs (10gms)	12hrs (25gms)	12hrs (50gms)	BIS: 10500-1993 Standards
1	Colour, Hazen Units	Clear	Clear	Clear	Colourless
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable
3	pH	7.25	6.08	5.84	6.50-8.50
4	Conductivity $\mu$ S (Micro Siemens)	<b>135</b>	<b>134</b>	<b>136</b>	NS
5	Total Dissolved Solids (mg/L)	<b>70.3</b>	<b>71.6</b>	<b>71.0</b>	500
6	Salinity	0.02	0.02	0.02	NS
7	Turbidity (NTU)	<b>1.0</b>	<b>1.1</b>	<b>1.0</b>	05
8	Dissolved Oxygen	<b>6.9</b>	<b>6.9</b>	<b>6.9</b>	NS
9	Calcium (mg/L)	4.0	8.0	8.0	75
10	Magnesium (mg/L)	2.43	-	-	30
11	Total Hardness (mg/L)	20.0	20.0	20.0	300
12	Total Alkalinity (mg/L)	18.0	18.0	20.0	200
13	Carbonates (mg/L)	10.8	10.8	12.0	NS
14	Bicarbonates (mg/L)	7.2	7.2	8.0	NS

Table No.4 showing physico – chemical test results of Group C (well water after 24 hrs of adding 10gms, 25gms and 50gms of quartz)

SI.No.	Parameters	24hrs (10gms)	24hrs (25gms)	24hrs (50gms)	BIS:1050-1993 Standards
1	Colour, Hazen Units	Clear	Clear	Clear	Colourless
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable
3	pH	6.24	5.81	5.73	6.50-8.50
4	Conductivity $\mu$ S (Micro Siemens)	<b>124</b>	<b>133</b>	<b>136</b>	NS
5	Total Dissolved Solids (mg/L)	<b>68.8</b>	<b>71.1</b>	<b>72.7</b>	500
6	Salinity	0.02	0.02	0.02	NS
7	Turbidity (NTU)	<b>0.9</b>	<b>1.1</b>	<b>1.1</b>	05
8	Dissolved Oxygen	<b>7.1</b>	<b>7.2</b>	<b>7.2</b>	NS
9	Calcium (mg/L)	4.0	4.0	4.0	75
10	Magnesium (mg/L)	2.43	4.86	2.43	30
11	Total Hardness (mg/L)	20.0	30.0	20.0	300
12	Total Alkalinity (mg/L)	18.0	18.0	18.0	200
13	Carbonates (mg/L)	10.8	10.8	10.8	NS
14	Bicarbonates (mg/L)	7.2	7.2	7.2	NS

### Microbial Load Analysis

Table No.5 showing microbial load analysis of Group A (untreated water) and Group B (filtered water)

Group A (Untreated water) (NOC) CFU/ml	Group B (Filtered water) (NOC) CFU/ml
528	375

Table No.6 showing microbial load analysis of Group C (well water after 6hrs, 12hrs and 24 hrs of adding 10gms, 25gms and 50gms of quartz)

SI. No.	Incubation Time	10gms (NOC) CFU/ml	25gms (NOC) CFU/ml	50gms (NOC) CFU/ml
1	6hrs	476	372	<b>369</b>
2	12hrs	732	668	<b>649</b>
3	24hrs	519	680	<b>951</b>

CFU – Colony Forming Units

NOC – Number of Colonies

### DISCUSSION

Acharya Sushruta has mentioned seven materials which can be used for purification of *kalusha* (polluted) water; they are *Kataka*, *Gomeda*, *Shaivala moola*, *Visagranthi*, *Vastra*, *Mukta* and *Mani*. The description about their use and procedures to be followed for purification has not been mentioned. We have to use various techniques and modifications which are available nowadays for their effective use. For the term *mani*, Acharya Dalhana has commented as *Sphatika*. When we go through various *Rasasastra-*

books we get the reference of *Sphatika* under *Uparasa* as third mineral drug i.e Potash alum as well as under *Uparatna* as Quartz. For this study quartz was taken. The effect of quartz on various parameters is as follows:

**Color:** Pure water is colorless. The color of the well water sample was clear. After 6, 12 and 24 hrs of adding of quartz also the color remains clear.

**Odor:** Drinking water should not have any kind of disagreeable odor. The odor was agreeable in all the samples. There was no change in odor after adding of quartz.

**pH:** The pH of untreated water was 6.78. After adding of quartz to the water samples the pH was found in between 5.50 – 7.50. As the quantity of quartz and time period increased, the pH value seemed to decrease. The pH of filtered water was found to be 5.27.

**Conductivity:** The conductivity of well water was found to be 122 before treatment, because of containing suspended solid particles. After adding of quartz conductivity is observed in between 124-138. As the quantity of quartz and period increased, the conductivity increased further. This suggests that quartz doesn't have coagulation property. The conductivity was found to be decreased after the water was subjected to filtration because the solid particles which were present in the sample were removed by the filter.

**Total Dissolved Solids (TDS):** TDS of water sample before treatment was 70.9. This is because of presence of some organic and inorganic substances in the well water. After adding of quartz, the TDS level was in between 67 to 73, which was slightly increased. After filtration the TDS of water was observed to be 29.5. This is because the solid particles were filtered by the filters.

**Salinity:** Salinity is the total salt dissolved in water. The salinity of both water samples before treatment and after filtration was observed as 0.02. After adding of quartz, the salinity was found to be same that is 0.02 as quartz is having *madhura* rasa (sweet taste).

**Dissolved Oxygen (DO):** Dissolved Oxygen is the amount of oxygen present in water. The DO of water samples before treatment and after filtration were 7.2 and 7.8 respectively. After adding of quartz, the DO was observed in between 6.9 to 8.9. The DO increased after adding of quartz.

**Turbidity:** Turbidity of water is due to the presence of inorganic substances or suspended particles. The turbidity of water should not be more than 5 NTU. The turbidity of untreated water was 3.0 and it decreased to 1.0 after filtration, this was due to the removal of suspended particles by the filters. After adding of quartz, the turbidity was found to be less than 1.1.

**Total Hardness:** Water hardness is due to presence of dissolved calcium and magnesium carbonates, bicarbonates and sulfates. The total hardness of the untreated as well as filter water was observed to be 30.0 mg/dl. The total hardness was found to be below 30 mg/dl after adding of quartz. After adding of quartz, the carbonate and bicarbonate increased, thus increased the hardness of water.

**Total Alkalinity:** The total alkalinity was observed to be 18.0 for both untreated and filtered water samples. TH and Alkalinity are directly proportion to each other. Hence, Alkalinity increases as TH increases, but the level may not be in same proportion. After adding of quartz, the total alkalinity increased and remained in between 18-22 because of increase in carbonate and bicarbonate and also TH.

**Calcium and Magnesium:** Dissolved calcium and magnesium are the two most common minerals that make water hard. The calcium was observed to be 4.0 mg/dl for both untreated and filter water samples. There was no change in the level of calcium after adding of quartz. Magnesium was 4.86 mg/dl for untreated as well as filtered water. It was below 5 after adding 10, 25 and 50 gms of quartz and after 6, 12 and 24 hrs. Calcium and magnesium of the entire water sample was within the normal values as per the standards.

**Carbonates and Bicarbonates:** The carbonate and bicarbonate levels for untreated and filtered water samples were found to be 10.8 and 7.2, respectively. Meanwhile carbonate and bicarbonate increased and were below 13.5 and 9, respectively after adding of quartz. There is not any specific guideline given for these two parameters according to BIS.

**Microbial Load analysis:** Drinking water should be free from any unwanted microorganisms or parasites. The bacterial colony count was 528 in untreated water sample. After filtration the bacterial count decreased when compared to untreated water. The bacterial colony count increased after adding of quartz. As the quantity and time period increased the bacterial colony count further increased. This highlights that quartz doesn't possess antibacterial action.



## CONCLUSION

The following conclusion can be drawn based on the experiment: A.) Quartz showed significant changes in parameters like DO and turbidity. B.) It reduced Salinity, TH and Mg; while increased pH, Conductivity, TDS, DO, TA, Carbonate and Bicarbonate. C.) There was not any change in Calcium after adding of quartz. D.) After adding of quartz the microbial colony count increased. E.) It doesn't have antimicrobial effect. It acts on certain parameters of purification. Quartz sand can be used as a medium in filters used for filtration. It can be assumed that other tools mentioned by *Maharshi Sushruta* might acts on other parameters. May be when these tools used in combination might give better results. Further research studies can be conducted to see the effect of these tools in combined form or alone.

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