

GE 15: TEXTILES: CARE AND CONSERVATION

UNIT II: MATERIALS AND PRACTICES IN CARE

MODULE 6: WATER- TYPES OF HARDNESS AND ITS REMOVAL

Outline

Sources of water

Types of water

Water hardness scale

Temporary and permanent hardness

Methods of softening water

Boiling method

Soda lime method

Zeolite Method

Learning Outcomes

Students will know about hard water

Importance of softening water

Methods of softening water

SOURCES OF WATER

Water comes from different sources. The rainwater falls onto the top level soil, middle level soil, and then goes down to the ground level. Rain water falls on the earth and the percolates down into the ground. The water that remains at the top level forms rivers, streams and ponds. At the middle level are springs, shallow wells and ground level water obtained from borewells. As this water is percolating through different levels of soil, it takes up various minerals and compounds from the soil.

TYPES OF WATER

There are two types of water-soft water and hard water

Hard water is that water that contains calcium and magnesium ions. When it contains calcium bicarbonate or magnesium bicarbonates it is called as Temporary Hardness of water

When water contains calcium sulfate or calcium chloride, it is Permanently Hardness of water. Magnesium salts of magnesium sulfate and magnesium chloride also make the water hard

WATER HARDNESS SCALE

The water hardness scale is given as parts per million. If water contains calcium and magnesium ions up to 50 parts per million, then the water is considered soft. Between 50 to 100 ppm, water is moderately soft. From 100 to 150 ppm water is slightly hard. 200 to 300 ppm water is hard and above 300 parts per million of calcium and magnesium ions water is very hard.

Water hardness

Hard water is classified as-Temporary hardness or carbonate hardness or alkaline hardness

The hardness causing compounds are calcium bicarbonate and magnesium bicarbonate, this type of hardness is removed by boiling. The permanent hardness or non-carbonated or non-alkaline hardness causing compounds are calcium sulfate, magnesium sulfate, ferrous sulfate, aluminum sulfate, and the chlorides are like calcium chloride, magnesium chloride and this type of hardness is not removed by boiling but needs other type of processes.

What are the problems caused by hard water?

- When water contains salts of calcium and magnesium the pipes of the water supply gets corroded. These minerals get deposited on the inside of the pipe and reduce the diameter of the pipe, and so the supply of the water gets restricted.
- During wet processing of the textile goods, the machinery gets corroded with hard water.
- During the dyeing process, if hard water is used the shades are dull
- When clothes are washed in hard water, the soap does not have leather, so sufficient soap has to be used to precipitate out the calcium and magnesium. In the process, scum is formed that has no cleaning power. This scum deposits on the clothes being washed and causes further soiling. Therefore, clothes washed in hard water develop a grey look and become uncomfortable to wear.
- When water contains salts of calcium and magnesium or other heavy metals, more soap is required for cleaning.

Soap

They are sodium and potassium salts of palmitic, stearic, and oleic acid. Sodium stearate with calcium chloride, resulting in hard water hardness. The calcium of this hard water combines with the soap and forms a complex. Therefore soap is not available for the washing

Eg.2- sodium palmitate and hard water causing compound calcium chloride combines with soap and makes soap not available for the washing purpose.

BOILING METHOD

The calcium bicarbonates, which is the temporary water hardness causing compounds, gets broken down into calcium carbonate, carbon dioxide and water. Similarly with the magnesium bicarbonate you get magnesium carbonate, carbon dioxide and water. So boiling does help in breaking down the temporary hardness of water.

LIME METHOD (calcium hydroxide)

Helps remove temporary hardness causing compounds.

Lime helps remove temporary water hardness causing compounds. The calcium bicarbonate and magnesium bicarbonate. An insoluble form of precipitate, calcium carbonate and water is formed.

Magnesium bicarbonate and lime- magnesium hydroxide and calcium bicarbonate, which requires more calcium hydroxide to be broken down into the insoluble form as a precipitate calcium carbonate and water.

SODA LIME METHOD FOR REMOVAL OF PERMANENT WATER HARDNESS

The permanent water hardness causing compounds are like calcium sulfate, magnesium sulphate and magnesium chloride

- 1) Soda reacts with calcium sulfate- sodium sulfate and calcium sulfate therefore soda helps to remove the permanent calcium sulfate and magnesium chloride hardness
- 2) Soda process for removal of temporary water hardness. Once again, the calcium bicarbonate and magnesium bicarbonate, which are the temporary hardness causing compounds.

ZEOLITE PROCESS

Zeolite combines with the calcium part of the water hardness, causing compounds and binds and therefore makes the water soft

Zeolites are also used for the removal of the permanent water hardness causing compounds like calcium sulfate and magnesium sulfate and calcium chloride.

- 1) See the reaction how the silicate binds with permanent water hardness causing compounds.

What is zeolite

A sodium aluminum silicate, a complex chemical compound which occurs as a natural mineral called zeolite. They are also synthetically made. Zeolites are insoluble in water and have the property of exchanging ions present in them with the ions present in water. So after some time it has exchanged all its sodium ions with the water hardness causing compounds and therefore it gets depleted.

Zeolite needs to be regenerated and sodium chloride is added. The zeolite gets once again regenerated. This is the diagram of the zeolite process. Hard water is made to enter into the chamber passing through the zeolite beads. The reaction takes place to get soft water, every time the zeolite gets depleted sodium chloride is added to regenerate the zeolite

What is the difference between soda lime process and zeolite process. These are the following differences. Example the residual hardness of 15 to 50 parts per million in water is for the soda lime process and the zeolite process the residual hardness of 10 to 15 ppm in water

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