Tastes and Odors in Drinking Water

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The literature on this subject runs into vast quantities, covering the causes, control methods and possible remedies, yet it remains one of the most difficult problems in water treatment and purification. The problem of producing a clear, soft and bacterially safe water has been pretty well solved, but that of palatability still defies the utmost efforts of research workers and experts in many instances.

The problem is complicated because very little is known about the compounds responsible for tastes and odors. We refer to water as having an algae, musty, or fishy odor, yet we have no idea as to the compounds which produce these odors.

There are many compounds responsible for objectionable tastes and odors in our public water supplies, yet the chemist probably cannot name five that have been identified as responsible for the more prevalent tastes and odors in water. Exclusive of the chlorinous taste, it is doubtful if the exact chemical compounds responsible for 1 per cent of them are known.

There seems to be nothing which works upon the disposition and imagination of the customers so much as a taste or odor in the drinking water. Many people still entertain fantastic superstitions concerning chemically treated water and its possible physiological effects and a taste of any kind in the water makes even those who do not ordinarily do so, feel apprehensive of some harmful effect.

The taste producing substances in water are so minute in quantity that they could scarcely be harmful even if poisonous, which they apparently are not. It has been definitely demonstrated that the sense of taste or smell is capable of detecting one part of oil of peppermint diluted in four hundred million parts of water. The chlorophenol or medicinal taste produced sometimes by chlorination can be detected in even a much greater dilution. So when we sometimes conclude from the taste that the operator has cast aside all restraint in the matter of the amount of chlorine used, there is in reality but one molecule of the chlorophenol compound in several hundred million molecules of water.

Sources of Tastes and Odors.

Plant growths of the algae type are the most common sources of tastes and odors in water supplies. Some of these organisms, if allowed to complete their life cycle, or if killed after attaining some growth, exude oils or decomposition products which impart a disagreeable taste to the water. Decaying vegetation, such as leaves, grass and moss, is often a contributing cause. These elements are particularly evident when rivers or reservoirs are low, and in swampy and stagnant areas. The above are the sources of most of the tastes encountered in the Lewiston supply.

Very severe and troublesome taste and odor conditions are often due to industrial waste pollution from such industries as coke plants, chemical plants, canneries, tanneries, oil refineries, dairies and creosoting plants. These are not so frequently encountered in less highly industrialized sections of the country.

An accurate knowledge of the sources of tastes in a water supply is of course necessary before intelligent treatment methods can be instituted by the water works operator for preventing or correcting the undesirable condition. With surface supplies such as streams and lakes, field trips along the shores of the stream or lake, made carefully and with a thoroly worked out methodical plan, will reveal much. Samples must be taken for microscopic examination, analysis, and other recognized laboratory follow up work.

Algae and the products of decaying vegetation and organic matter have been the sources of the tastes encountered in our Lewiston supply the past two years. Previously it was a medicinal or chlorophenol taste. The period

of tastes comes in the late summer when the water is low and the plant growth is at its height. Our supply comes from the Clearwater river and is treated and filtered.

The Term "Algae"

The following definition of algae is given by George C. Whipple in his book "Microscopy of Drinking Water": "The term 'algae' is used to cover several phyla of primitive plants, capable of elaborating their own carbohydrate supply by means of photosynthesis, usually without differentiated vegetative structures. Most of them live entirely submerged in water, and several groups, including the most highly developed in their vegetative structures are almost exclusively marine. They are found floating freely at the surface, attached to stones or clinging in gelatinous masses to the submerged portions of the more highly organized aquatic plants. A few prefer damp situations in which they do not become immersed at all, or only periodically become covered with water." Practically all that is required by these organisms for growth in water is carbon dioxide and sunlight, consequently they are very plentiful. They will grow in any clear water suitable for a water supply when exposed to sunlight.

Tastes Produced

The types of tastes produced by these plant organisms can be roughly classified in the following manner:

Earthy and fishy odors are caused by diatoms and some of the green algae.

Marshy or swampy odors by the green algae.

Aromatic or geranium odors by the diatoms.

Some of the protozoa cause such odors as candied violets and others a ripe cucumber, bitter or muskmelon taste.

The character of these tastes or odors change with the varying concentrations with which they are present in the water. The first noticeable odor of diatoms is earthy and as the intensity increases, it becomes aromatic and then fishy . The fishy odor noticeable when a stream recedes quite rapidly from its higher stages is usually caused by exposing to the air and killing the diatoms which were growing on the bottom along its shore lines. Some even ascribe the fishy odor of fish to the diatoms which are an important source of food for them.

Tastes Caused by Chlorine

The most troublesome and persistent taste encountered in chlorinated supplies is a medicinal or iodoform taste. This taste is easily detected in even greater dilution than one part in four hundred million, as before mentioned. It cannot be boiled off, but ruins both tea and coffee. It cannot be hidden by lemonade or punch, but seems even worse when the water is used in these drinks. Ice made from water containing this medicinal or chlorophenol taste carries it full strength. People frequently mistake this taste for that of chlorine which is quite different and some think iodine has been put in the water.

The substances or chemical combinations entering into this reaction with chlorine are not well known except that phenols and organic substances in solution will cause it. The chlorine dosage must also be sufficient to produce a certain oxidation potential. Among the possible remedies for chlorophenol or medicinal tastes, one of them, strangely enough, is chlorine.

Control Methods

One of the boldest and most sensational remedies for tastes and odors in drinking water has been the use of chlorine. Chlorine itself has been one of the worst offenders and yet it is one of the most successful remedies. The solution has been not less chlorine, but more, a great deal more. This method is called super-chlorination or break-point chlorination. Enough chlorine is added to the water to completely oxidize or burn up the taste producing substances. A dechlorinating agent is then used to remove the excess chlorine if any and the taste is gone, leaving the water fresh and clean.

I would like to tell you briefly of a classic instance where this treatment

was used. I believe you will find it interesting.

Ottumwa, Iowa, with a population of about 3500 is located on the Des Moines River, 107 miles down river from the state capital of Des Moines. Ottumwa gets its water supply from the Des Moines river. In the winter of '39 and '40 the river reached a very low stage. Des Moines was discharging 14 million gallons per day of raw sewage into 12 million gallons of natural river flow, so that the river was more than half raw sewage.

Severe weather froze the river over with a solid sheet of ice 15 to 18 inches thick, which was covered with a heavy blanket of snow, thus forming a closed conduit from the Des Moines sewers to the raw water intake at Ottumwa. Septic conditions immediately set in and you can readily imagine the odor and condition of the water supply at Ottumwa.

It was a desperate situation and called for strong measures. Break-point chlorination was decided upon when nothing else gave results. It was necessary to feed chlorine from twelve one-ton containers at one time to get sufficient chlorine into the water for results. The colossal amount of 934 pounds of chlorine were used in each million gallons of water. This combined with the organic matter present and formed a precipitate which resembled clotted blood. After sedimentation and filtration the water came out clear and sparkling with no taste except for a very slight and unobjectionable woody taste. The papers referred to this treatment as "Super-Colossal Chlorination." Ottumwa can surely boast of some very brave men in the water department.

In Lewiston we have eliminated the chlorophenol or medicinal taste which troubled us in the late summer and fall seasons by the use of chloramines. Ammonia is added first and as soon as this is thoroly mixed, the chlorine is applied, the two forming what is called chloramines. The ammonia prolongs the sterilizing effect and reduces the oxidation potential of the chlorine preventing the formation of chlorophenols or other taste producing compounds.

Activated carbon has been used successfully in many places, but has proved rather expensive in some instances. The carbon absorbs the tastes or odors and is then filtered out. An interesting fact concerning powdered activated carbon is the tremendous surface area it presents to the water. A single cubic inch of it has been calculated to contain twenty thousands square yards of surface, an almost incredible amount. However, when you get a speck of it on you and try to wipe it off, it seems to go about that far.

This matter has of necessity been dealt with in a sketchy manner, but if this outline has given you a few of the things the water works operator is up against in respect to this problem, it has served its purpose.