



AGRICULTURAL INDUSTRY AND WATER QUALITY

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WHAT IS “AGRICULTURAL INDUSTRY”?

Industrial processing of agricultural products includes both food and non-food processing industries (including pharmaceuticals). These processing activities transform raw plant or animal materials into processed products through labour, machinery, energy, and scientific knowledge.

IS WATER QUALITY IMPORTANT FOR PROCESSING AGRICULTURAL GOODS?

Yes, water quality is of concern for many different industrial processes. Poorer quality water or, in some cases, treated effluent is often used for cooling and gas scrubbing, and in condensers and exchangers. For most food and non-food processing activities, a supply of high quality water is also required. These industries may commonly find that the water supplied by the local municipal water treatment plant requires additional treatment to improve the quality for industrial needs.

For industries that use water as part of a food or beverage product, significant measures may have to be taken in order to ensure that the water is palatable and safe, especially if these products are to be exported or require a long shelf life. Recent information from industrialized

countries indicates that up to 10% or more of the population may suffer from food-borne illness annually. Many food-borne pathogens (disease-causing microorganisms) are also transmittable by water.

There are therefore many reasons to take precautions to avoid contamination of food throughout all the stages of agricultural production. These range from raising crops or animals through to manufacturing, distribution and retailing of agricultural products. The farm to consumer food chain is vulnerable in many points and must be protected to ensure the safety of the processed farm product.

WATER QUALITY GUIDELINES FOR THE FOOD AND BEVERAGE INDUSTRY

The water quality guidelines for the food and beverage industry have been compared with the Canadian Drinking Water Quality Guidelines in Table 1. This table also highlights potential problems with Saskatchewan water supplies. Several food processing and beverage manufacturing activities are covered in the table. Guideline values suitable for human consumption, but unsuitable for one or several processing industries, have been highlighted in grey. Many industrial processes require water that is of higher quality than that which is presently supplied by existing municipal water treatment plants and/or which is required by the Canadian Drinking Water Quality Guidelines.

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Agriculture and
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Table 1 Water quality guidelines for the food and beverage industry compared with Guidelines for Canadian Drinking Water Quality. Areas in grey can be of concern for specific food processing industries in Saskatchewan (modified from Canadian Council of Ministers of the Environment 1987)

Parameter	Concentration (mg/L)								
	Drinking water guideline	Baking	Brewing	Carbonate beverages	Confectionary	Dairy	Food canning, freezing, dried, frozen fruits, vegetables	Food process (general)	Sugar manufacturing
pH	6.5-8.5	-	6.5 to 7.0	<6.9	>7.0	-	6.5 to 8.5	-	-
Colour (Hazen Units)	15	<10	<5	<10	-	ND	<5	5 to 10	-
Turbidity (NTU)	1	<10	<10	1 to 2	-	-	<5	1 to 10	-
Taste, odour	concern	low	low	ND ^a	low	ND	ND	low	-
Suspended solids (mg/L)	concern	-	-	-	50 to 100	<500	<10	-	ND
Dissolved solids (mg/L)	500	-	<800	<850	50 to 100	<500	<500	<850	-
Calcium (mg/L)	concern	NS ^{bc}	<100	-	-	-	<100	-	<20
Magnesium (mg/L)	concern	-	<30	-	-	-	-	-	<10
Iron (mg/L)	0.3	<0.2	0.1 to 1.0	<0.1	<0.2	0.1 to 0.3	<0.2	<0.2	<1
Manganese (mg/L)	0.05	<0.2 ^d	<0.1 ^d	<0.05	<0.2 ^d	0.03 to 0.1	<0.2	<0.2	<0.1
Copper (mg/L)	1	-	-	-	-	ND	-	-	-
Ammonium (mg/L)	concern	-	-	-	-	trace	<0.5	-	-
Bicarbonate (mg/L)	concern	-	ND	-	-	-	-	-	<100
Carbonate (mg/L)	concern	-	<50	<5	-	-	-	-	-
Sulphate (mg/L)	500	-	<100	<200	-	<60	<250	-	<20
Chloride (mg/L)	250	-	20 to 60	<250	<250	<30	<250	-	<20
Nitrate (mg/L)	10	-	<10	-	-	<20	<10	-	-
Fluoride (mg/L)	0.3	-	<1	0.2 to 1.0	-	-	<1	<1	-
Silica (mg/L)	concern	-	<50	ND	-	-	<50	-	-
Hardness (mg/L)	concern	NS ^b	<70	200 to 250	-	<180	<250	10 to 250	<100
Alkalinity (mg/L)	concern	-	<85	50 to 128	-	-	30 to 250	30 to 250	-
Hydrogen sulphide (mg/L)		<0.2	<0.2	<0.2	<0.2	-	-	-	-
Oxygen consumed (mg/L)	concern	-	-	<15	-	-	<1	-	-
Carbon tetrachloride extract (mg/L)		-	-	slight	-	<10	<0.2	-	-
Chloro form extract (mg/L)		-	-	<0.2	-	-	-	-	-
Acidity		-	-	-	-	-	ND	-	-
Phenol		-	ND	ND	-	-	ND	-	ND
Nitrite		-	-	-	-	-	ND	-	-
Organic matter	concern	-	trace	trace	-	-	-	-	trace

a) not detected = ND, b) some required for yeast action, c) not specified = NS, d) Total Fe and Mn

IS WATER QUALITY IMPORTANT TO INDUSTRIAL AGRICULTURAL PROCESSES?

Apart from the actual manufacture of products, there are several other agricultural processing applications. Included among these are: steaming (boilers, air humidifiers), heat exchange (condensation of steam, cooling of fluids and solids, heating), washing of solids,

transport of solids, and surface rinsing. Water can be used in one-pass systems (consumptive use), in re-circulation (with or without water deterioration), and for reuse (for two different purposes).

Water quality issues that are frequently encountered in several of the above processes include:

- fouling (all substances other than scaling that deposit or form in a system)
- scaling (precipitation of sparingly soluble salts of calcium and possibly silica)

Fouling and scaling lead to a variety of processing problems, including corrosion and loss of flow. Treatment techniques to prevent fouling and scaling include water softening, pH adjustment, elimination of nutrients and the addition of bacteriostatic/algistatic compounds to the process water to prevent the growth of microorganisms.

In some cases, a higher purity of water is actually necessary for the industrial process. For example, a higher purity of water is required to clean stainless steel vessels than for the drinking water supply of the milking cows.

THE USE OF SASKATCHEWAN SURFACE AND GROUND WATER FOR INDUSTRIAL PROCESSES

Many water quality requirements of the food and beverage industry exceed those established for drinking water by the Guidelines for Canadian Drinking Water Quality. Colour, turbidity (including microorganisms), taste and odour, suspended and dissolved solids, iron and manganese, and ammonium may all present challenges if municipal water is used for food processing purposes without additional water treatment. Bicarbonate, carbonate, sulphate, chloride, nitrate, fluoride and silicate can also present problems.

Fouling compounds (particulate and dissolved organic matter) and scaling compounds (calcium, magnesium, silicates and carbonates) have no drinking water guidelines associated with them, but can cause problems for several food processing sectors.

WHERE CAN I GET MY WATER ANALYZED?

Commercial and provincial laboratories that are able to analyze the composition of chemicals in water include: Envirotest Laboratories (Saskatoon), BDS Laboratories (Qu'Appelle), and Saskatchewan Research Council (Saskatoon).

THE BIGGER PICTURE

Water quality is an important consideration in all aspects of industrial agricultural processes as well as in the value-added agricultural product. It is therefore imperative that industry select the appropriate water source for its intended use. Food and non-food processing is also intimately linked with effluent disposal. In some jurisdictions, processors must pay close attention to the amount of effluent produced (volume of water and amount of organic matter). Industries that adopt effective water reduction or conservation techniques and develop water optimization strategies (including water quality improvements) can often achieve significant economic savings by reducing operating costs, as well as dramatically reducing the potential for negative environmental impact caused by the discharged effluent. The issue of microorganism removal from water used in the manufacturing of agricultural products (food and beverage) has not yet become critical in Saskatchewan, but it is anticipated that this will occur during the next several years, particularly for commodities that are exported.

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This Fact Sheet is a part of the publication Water Quality Requirements for Saskatchewan's Agri-Food Industry, identifying key water quality needs for each sector. These guidelines were compiled from a variety of references, primarily including extension publications, reports, books and internet sources. Water quality is a vast and complex subject and readers are encouraged to consult with experts and refer to the scientific literature for a greater understanding into specific water quality needs.

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