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MEXICO WATER REPORT

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Potable Water Treatment and Plants in Mexico

Every foreigner has heard the advice and general expression: “When you go to Mexico, don’t drink the water.” However, most Mexicans don’t hesitate in uttering this same generalization. Potable water problems in the developing world are difficult, but Mexico faces these traditional problems along with other barriers that make the delivery of 100% potable water to the population that much more challenging.

Most people in Mexico do not drink from the tap because they do not trust the water quality. Even though water treatment plants produce potable water, it gets polluted in the delivery system and the chlorination methods used in 80% of the processes don’t prevent this contamination.

The traditional developing world potable water challenge that Mexico faces is based on two issues. One is competition for public infrastructure funds. Even when water is a priority, wastewater solutions tend to be a greater priority than potable water issues, especially in major urban areas.

The second challenge is keep water truly potable, not only at the plant but also at the point of consumption. Over 50% of Mexican potable water is lost in the delivery system and never makes it into a home. However, the most important qualitative problem lies in the fact that this leaky delivery system also contaminates the purified water. Until this problem is addressed, it is hard for developing world water commissions to know how to apply appropriate technology and financial resources to solve this problem.

A third challenge, unique to Mexico, lies in the fact that the Mexican population, especially in urban areas, has come to rely on bottled water for its potable water supply. The second issue of the Mexico Water Report included a discussion of the importance of the Mexican bottled water market which is second in the world in per capita consumption and market revenue. As long as the Mexican population relies on bottled water, it will be hard for the Mexican government at federal or local levels to justify financial expenditures for the type of comprehensive projects needed to provide consistent potable water.

Current Mexico Potable Water Reality

Currently, 91% of Mexico has potable water service. According to the latest published information, potable water coverage in urban areas is 94%. It is interesting to note that in 2005, urban potable

water coverage was actually better (95%) than four years later in 2009. This statistic is somewhat alarming but is at least partially explained by the fact that Mexico is finding it hard to keep up with the continuing and increasing urbanization challenges which make it possible for coverage to deteriorate a full percentage point.

On the other hand, while one might conclude that rural area potable water coverage is unacceptably low, it has made some considerable advances, going from 51.2% in 1990 to 70.7% in 2005 and 79% in 2009.

When analyzing potable water coverage by state, it is clear that the more developed areas of the country are making more progress while the least developing areas seem to be languishing. Fifteen of Mexico's 32 states have potable water coverage above 95% and only eight states are below the national average of 90.7%. However, of these states, seven are below 85% with four at or below 80%: Tabasco, Veracruz, Chiapas, and Guerrero.

Mexico's ambitious 2030 water program establishes 100% potable water coverage as a goal. Brazil has made an identical 2030 commitment. Parallel to this goal, the Mexican government established a more realistic 2012 goal of 92% nationwide potable water coverage. While this goal might end up being met, this loftier 2030 goal seems out of reach because of its very ambitious nature and because of the above-mentioned traditional and Mexico-unique potable water challenges.

Potable Water Plants, Capacity and Flows

The latest published figures by the Mexican Water Commission (CONAGUA) are somewhat confusing and perhaps not congruent. Conagua information claims that the 631 potable water treatment plants in Mexico had an installed capacity of 133 m3/s and that they processed 90 m3/s per year in 2009. However, they also say that of the total national potable water supply (328.2 m3/s), 62% or 203.5m3/s of is from subterranean water sources with the rest (38%) or 124.7m3/s coming from surface water sources. They also say that only 83.1m3/s of surface water sources or 1/3 is actually treated. As a result, we are uncertain how Conagua can call this 1/3 of surface water sources "potable" if it is never treated.

Operating potable water plants by region (2009)

Region	Hydro Administrative Region		Number of operational plants	Capacity	Potable Flow
Northwest	I	Peninsula de Baja California	41	12.22	6.66
	II	Noroeste	24	4.13	2.14
	III	Pacifico Norte	154	9.28	7.75
North	VI	Rio Bravo	60	26.3	15.9
	VII	Cuencas Centrales del Norte	67	0.56	0.4
	IX	Golfo Norte	43	6.66	5.89

Central	VIII	Lerma-Santiago-Pacifico	112	19.95	12.48
	XIII	Aguas del Valle de Mèxico	43	5.27	4.17
Southwest	IV	Balsas	20	22.76	17.28
	V	Pacifico Sur	8	3.18	2.59
Southeast	X	Golfo Centro	9	6.64	4.15
	XI	Frontera Sur	49	16.13	10.63
	XII	Peninsula de Yucatàn	1	0.01	0.01
Total			**631**	**133.09**	**90.04**

There are 631 water treatment plants divided into 5 regions. The Northwest has over 1/3 of the total number of treatment plants with 219. The Southwest has the fewest plants (only 28 plants representing less than 5% of the total). However, the number of water treatment plants does not necessarily correspond to higher installed capacity or treated flows. The installed capacity for these 631 treatment plants is 133.09 m3/s while the total treated flow is only 90.04 m3/s or only 2/3 of their capacity. With the exception of the potable treatment plants in the Southwest region that are working at close to 80% capacity, all other regions were at or well below 2/3 capacity in 2009.

The states with the largest number of potable treatment plants are Sinaloa with 142 plants or 22.5% of all potable plants in the country, followed distantly by Tamaulipas and Zacatecas each with 54 plants. The states with fewest plants are the State of Mexico (11), Nuevo Leon (12), Baja California (26) and Mexico City (38). However, in general, these plants treat some of the highest capacities in the country.

Although the State of Mexico and the Federal District which make up the Greater Mexico City area have very comparable populations, the difference between the number of potable treatment plants and the treated flows in these jurisdictions is quite dramatic. The State of Mexico, with its 11 plants, has an installed capacity of 22,164 m3/s and processes 16,739 m3/s annually while the Federal District, with its 38 plants, has an installed capacity of only 3,788 m3/s while processing 2,935 m3/S. Thus, the Federal District has less than 15% of the capacity and only 17.5% of the treated flows of the State of Mexico which demonstrates the evidently small size of the plants in the Federal District.

The situation is similar in Sinaloa which has the largest number of plants in the country (142) with an installed capacity of only 9,267 m3/s, processing 7,743 m3/s, representing only about 40% of the capacity and less than half of the treated flow from the potable treatment plants in the State of Mexico.

New plants are probably required in states with little unused capacity like Sinaloa and Zacatecas (at virtual full capacity now) or Tamaulipas (above 80% capacity). However, in most Mexican states,

especially important states like Baja California, Nuevo León, the Federal District, and the State of Mexico, there still seems to exist ample capacity for treating potable water.

Therefore, from this analysis of the existing information on potable water treatment plants, one can conclude that the extensive, regionally unused capacity (1/3) consistently suggests that the solution to the potable water problems is probably not investing in the construction of new potable treatment plants but the maintenance and renovation of the existing plants to take advantage of more of the existing installed capacity. That being said, this analysis does not take into consideration water quality or efficiency issues which could very well dictate the need for new plants or the modernization of existing plants.

Potable water standards and purification processes

To regulate potable water supply and distribution systems, the Secretary of Health has established three main standards: (a) NOM-230-SSA1-2002 which covers compliance with health requirements in the supply systems, (b) NOM-127-SSA1-1994 y which covers regulation of the permissible limits of quality and treatment that water, and (c) NOM-179-SSA1-1998 which covers monitoring and evaluation of the water quality control. These regulations together establish the basis for potable water purification and disinfection.
Mexican potable water treatment plants use 10 purification processes.

Central Process	Process Description	Capacity		Potable Flow	
		No.	%	m3/s	%
Softening	Hardness Removal	21	3.3	0.63	0.7
Absorption	Trace Organic Removal	15	2.4	0.84	0.9
Conventional Clarification	Suspended Solids (TSS) Removal	195	30.9	62.29	69.2
Patent Clarification	TSS Removal	140	22.2	6.64	7.4
Reversible Electrodialysis	Dissolved Solids Removal	1	0.02	0.06	0.01
Direct Filtration	TSS Removal	62	9.8	14.19	15.8
Slow Filters	TSS Removal	7	1.1	0.38	0.4
Reverse Osmosis	Dissolved Solids Removal	174	27.6	1.29	1.4
Iron and Manganese Removal	Iron & Manganese	16	2.5	3.73	4.1
Total		**631**	**100**	**90.04**	**100**

Conventional clarification is the most frequently used process used at 195 plants or 31% of the total. These plants are responsible for 70% of the total water treated. While reverse osmosis plants are second in frequency with 174 representing, almost 30% of all plants, they are responsible for an insignificant 1.4% of total treated flows. The third and fourth most frequently used processes, patent clarification (140 plants) and direct filtration (62 plants), are together responsible for almost 25% of the total water treated. The remaining 5 processes mentioned above have a modest number of plants

(61 total or less than 10%) and are used to treat less than 6% of total flows. The primary function of almost two-thirds of potable treatment plants is the removal suspended solids.

Conventional clarification technology is used in the largest plants, and in 20 of the 32 states it is the most important treatment process. In 14 states, the treated amounts are significant, ranging from 1,500 l/s to over 15,000 l/s. It is interesting to note that half of all treatment by conventional clarification, representing over 1/3 of all potable water treated, is generated in the states of Mexico (only 6 plants processing 15,559 l/s), Tamaulipas (29 plants processing 10,039 l/s) and Jalisco (15 plants processing 8,620 l/s) alone. Also, if the state of Tabasco, the fourth most important state for conventional clarification (30 plants processing 6,010 l/s) is included in the mix, these four states represent 2/3 of all of the water treated by conventional clarification.

In the States of Mexico and Jalisco, conventional clarification processes are used to treat more than 90% of all water treated. In Tabasco and Tamaulipas, conventional clarification is responsible for about 80% of all water treated. While treatment amounts are less significant, it is worth noting that Sinaloa has 30 plants and Sonora 24 plants that together treat almost over 5,000 l/s.

Treatment processing plants with other, alternative methods appear to have distinct preferences by water authorities in certain parts of the country. Patent clarification processes are used extensively in the states of Sinaloa (106 plants, 45% of total treatment) and Tabasco (8 plants, 20% of total treatment), and the state of Sinaloa has 6 iron & manganese plants that produce close to 40% of all water using this process. While insignificant in terms of treated flows, the following states have double digit reverse osmosis plants which represent close to 1/3 of all treatment plants in Mexico: Colima (32), Durango, (31), the Federal District, Baja California Sur, and Guanajuato.

Of the 12 states that do not rely heavily on conventional clarification process, only four treat significant amounts of water with other processes. In Nuevo Leon, 85% of water treatment, or 6,165 l/s, are produced in just two large plants using direct filtration processes. The other 15% is from 7 plants using conventional clarification methods. Baja California is very similar, where 75% of water treatment, or 4,873 l/s, are produced in 16 smaller plants using direct filtration while the other 25% is from 9 plants using conventional clarification methods.

About half of the 32 Mexican states treat insignificant amounts of water (less than 500 l/s), with 13 states treating less than 250 l/s and 10 states (almost 1/3) without plants (5) or treating less than 25 l/s (5). In southern Mexico where subterranean and surface water sources are plentiful, only the state of Tabasco does any significant potable water treatment. The arid northern states that have access to surface water (Baja California, Nuevo Leon, Sinaloa, and Tamaulipas) treat significant amounts of potable water, equal to more than 1/3 of all potable water treated in Mexico. On the other hand, the rest of northern Mexican states treat virtually no water at all.

Disinfection and Disease Control Challenges

In order to understand potable water treatment issues, one must understand disinfection realities and their impact. This final step in the water purification process is now carried out in 97% of the potable water supply, increasing almost 20% points since 1991 and over 8% points from 1991 to 1992 alone, climbing from 84.5% to 92.7% coverage.

Year	Supplied water (l/s)	Disinfected water (l/s)	Coverage %
1991	240 075	202 900	84.5
1992	247 580	229 400	92.7
1993	249 692	237 149	95
1999	309 774	287 147	92.7
2000	312 007	294 400	94.4
2005	324 467	311 295	95.9
2009	**328 176**	**318 647**	**97.1**

In the early 1990s, the Latin American disinfection average was 84% while Mexico was beginning to reach 95%. The decrease from 1993 through 1999 is possibly the result of the severe 1994 economic crisis. However, since that time there has been a steady increase in the disinfection levels in Mexico, growing by 5% points during the last 10 years. In fact, only the states of Chiapas (83.1%) and Guerrero (88.2%) present serious areas of concern. Only two other Mexican states (Yucatan and San Luis Potosi) have disinfection coverage of less than 95%.

While the Mexican track record for disinfection appears to be good, it has not resulted in significant advances in the control and eradication of infectious diseases like typhoid and salmonella, two of the most dangerous digestive system diseases in Mexico.

Cases of Infectious Diseases in Mexico since 2002					
Disease	**Number of cases per year**				
	2002	**2004**	**2006**	**2008**	**2009**
Infectious Diseases	6 831 630	5 951 869	5 765 081	5 500 546	5 493 987
Typhoid	7 889	25 952	37 012	44 199	46 724
Salmonella	80 494	109 444	115 014	120 986	137 270
Shigellosis	31 473	22 321	16 483	12 885	12 441

The overall number of infectious diseases is down 20% and Shigellosis down over 60% from 2002 levels. However, the Typhoid and Salmonella situations appear to be worsening considerably, with the number of cases of Typhoid up 600% and Salmonella up 70% annually since 2002.

While Mexico's population growth has stabilized relative to many other developing countries, the population shift from rural to major urban areas has been difficult to manage and made controlling these diseases that much more difficult. However, these kinds of increases cannot be attributed strictly to population relocation issues and must become higher priorities for funding and actions by Mexican federal and major municipal authorities.

As a result, moving forward, we expect to see greater emphasize on disinfection campaigns, greater funding for colloidal silver and calcium hypochlorite supplies, and a more strict, intensive and extensive enforcement of NOM-179-SSA1-1998 to guarantee greater precision in the disinfectant dosages and increased monitoring of disinfection equipment.