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MEXICO WATER REPORT

Lga Consulting

Water Quality Problems and Challenges in Mexico

The lack of confidence in Mexican potable water supply and in general superficial water sources has caused the country to position itself as one of the major consumers of bottled water in the world utilizing 234 liters per capita, one of the highest in the world. Naturally, over 80% of Mexicans are not satisfied with the water quality coming into their homes and don't drink it fearful of contracting diseases because of the lack of treatment and aquifer pollution. Water quality is also affected by water pollution problems from somewhat uncontrolled municipal and industrial discharges and the insufficient monitoring and low compliance with related regulations. Furthermore, it is important to mention that in 2010, according to the United Nations Development Program, Mexico was 106 out of 122 countries in water quality.

NOMS for water quality in Mexico

There are 3 NOMS or Mexican norms that regulate water quality in the country: NOM-127-SSA1-1994, NOM-179-SSA1-1998 and NOM-230-SSA1-2002. NOM-127 establishes the bacteriological and physical chemical limits for human consumption, NOM-179 regulates the surveillance procedures that water authorities must meet to remain in compliant with NOM-127, and NOM-230 establishes the sanitary requirements that public and private supply systems must meet. To obtain results and compliance information on these 3 NOMS, Mexico has a water quality monitoring network.

National Water Quality Monitoring and Laboratory Networks

To monitor and help control the water quality of surface water, Mexico has a National Monitoring Network with 1,510 test sites divided in 4 networks: primary, secondary, special studies and ground water reference. These sites are also divided or classified according to the applicable water source: surface bodies, coastal zones and ground waters. According to CONAGUA officials, in order to properly monitor BOD and COD indicators, Mexico needs to at least double the number of monitoring sites, something that Conagua says is a medium term if not a short term priority.

National Networking Monitoring Locations		
Network	**Area**	**Number**
Primary Network	Surface Bodies	220
	Coastal Zone	78

	Ground Water	150
Secondary Network	Surface Bodies	272
	Coastal Zone	23
	Ground Water	45
Special Studies	Surface Bodies	162
	Coastal Zone	53
	Ground Water	409
Ground Water Reference Network		98
Total		1510

Mexico also has a national laboratories network composed of 13 laboratories located in major water basin administrative centers and 15 laboratories located in state Conagua offices located outside of these basins. These 2 networks monitor the levels of physical chemical and bacteriological substances. In order to assist with this problem, in 2012 Conagua will begin to implement a 5 year program to subcontract an important part of the monitoring responsibilities to private companies/laboratories that will allow for the monitoring and measurement of all of the substances currently mentioned in the different Mexican wastewater and potable water regulations. With additional monitoring it is expected that more problems will be detected and new and higher fines will be issued which hopefully will lead to a greater and more dynamic demand for wastewater equipment and technology.

Mexico Water Quality Monitoring Results: BOD, COD, and TSS

To evaluate the water quality of surface bodies and determine the organic matter quantity in water bodies, 3 main indicators are used in Mexico: BOD, COD and TSS. The BOD indicator (Biochemical Oxygen Demand) measures the quantity of oxygen needed for a given organism to oxidize the organic matter. COD (Chemical Oxygen Demand) measures the total chemical oxidant which consumes organic matter. The TSS indicator (Total Suspended Solids) measures the capacity of a water body to support diverse aquatic life. Below is a table with the number of monitoring locations for each one of these indicators, virtually all of which are located in high human impact (anthropogenic) areas.

Number of Monitoring Locations	
Water Quality Indicator	**Locations**
BOD	605
COD	646
SST	744

BOD

According to Conagua authorities, of the 3 indicators, BOD is of the most concern in terms of the level of contaminants and toxicity. Based on monitoring results from the BOD monitoring sites, 7.9% of national water is considered“contaminated” and 4.6% is considered“highly contaminated”. This is especially the case in central Mexico where 75% of Valley of Mexico water region is“contaminated” or “highly contaminated”. Likewise, the other three river basin regions in Central Mexico, Lerma-Santiago-Pacific, Balsas and Central Gulf, have 15-18% of their water supplies “contaminated” or “highly contaminated” with BOD. In the north, there are two river basin regions with BOD problems, Rio Bravo and Baja California’s peninsula where respectively 20.6% and 18% of their waters are considered to be “contaminated” or“highly contaminated”.

However, there are some regions with positive results. 41% of the waters in the national network had “excellent”quality according to the monitoring done for this indicator. Over 70% of the waters in seven of the thirteen major river basins have“excellent” or “good” BOD water quality and 5 basins (Yucatan Peninsula, North Central, North Gulf, North Pacific, and South Border) have “excellent”or “good” quality in over 80% of their waters.

Distribution Percentage of monitoring locations in surface water by Water Region according to BOD Indicator

River Basin Regions		Excellent	Good	Acceptable	Contaminated	Heavily Contaminated
I	Baja California Peninsula	27.3	9.1	43.5	13.6	4.5
II	North East	50	26.5	23.5	0	0
III	North Pacific	70.7	12.2	17.1	0	0
IV	Balsas	16.6	23.8	41.7	13.1	4.8
V	South Pacific	0	0	0	0	0
VI	Río Bravo	48.6	46.2	2.6	20.6	0
VII	North Central Basin	90	10	0	0	0
VIII	Lerma-Santiago-Pacific	48.7	9.3	24	12.7	5.3
IX	North Gulf	80.9	11.9	4.8	2.4	0
X	Central Gulf	0	70.3	13	11.1	5.6
XI	South Border	0	86.1	13.9	0	0
XII	Yucatán Peninsula	90	0	10	0	0
XIII	Valley of Mexico	40.2	0	20.8	25	50

Total	41	26.8	19.7	7.9	4.6

The Mexican states that count with good water quality in terms of BOD are Jalisco, Nuevo Leon, Tamaulipas, Veracruz, Aguascalientes, Chihuahua and Baja California. According to the results of monitoring by state, the states that most require treatment for BOD are the Federal District and the State of Mexico (Valley of Mexico and Valley of Toluca), Guanajuato and Tlaxcala where monitoring sites are detecting over 30mg per liter of BOD. All of these states are located in the central part of the country where most of the population and industry are concentrated. In summary, two-thirds of water samples tested for BOD are classified as "good", over 85% fall with in the "acceptable" range ("Excellent", "Good", or"Acceptable") while 12.5% where not acceptable ("contaminated" or "heavily contaminated"). These are better test results than those obtained for COD but considerably higher than those for TSS.

COD

BOD is an important indicator of the toxicity levels in Mexican Waters. According to monitoring results, it is the only indicator that does not have at least two-thirds of its sample results as"excellent" or "good", with only 50.4% reaching these higher levels and less than 60% reaching the minimum acceptable classification of"acceptable". The table below shows the results of the monitoring for BOD, demonstrating that 23% of national surface waters are considered "contaminated" and 7.5% "highly contaminated". Again, the Valley of Mexico water region is the most contaminated in the country with 54% considered "highly contaminated" and 23%"contaminated." As a result, less than 25% of the Federal District and State of Mexico water supply can be considered appropriate for human use.

Distribution Percentage of monitoring locations in surface water by Water Region according to COD Indicator						
River Basin Regions		**Excellent**	**Good**	**Acceptable**	**Contaminated**	**Heavily Contaminated**
I	Baja California Peninsula	4.5	0	13.6	68.2	13.7
II	North East	43.5	17.7	24.2	14.5	0.1
III	North Pacific	11.7	41.2	11.8	35.3	0
IV	Balsas	9.5	21.4	27.4	28.6	13.1
V	South Pacific	96	0	4	0	0
VI	Río Bravo	51.6	39.8	1.1	7.5	0
VII	North Central Basin	25	30	45	0	0
VIII	Lerma-Santiago-Pacific	4	17.3	26.7	42	10
IX	North Gulf	55.6	22.2	11.1	6.7	4.4
X	Central Gulf	39.6	8.3	22.9	25	4.2

XI	South Border	16.6	50	13.9	13.9	5.6
XII	Yucatán Peninsula	55	30	10	5	0
XIII	Valley of Mexico	4.1	0	12.5	29.2	54.2
Total		28.3	22.1	18.6	23.5	7.5

In addition to the Valley of Mexico problems, we found similar problems with other river basin regions in central Mexico. There exist serious COD pollution problems in the Lerma-Santiago-Pacific river basin region and in the Balsas river basin region where 50% and 42% of the waters respectively are considered“contaminated” or “highly contaminated” with COD. Likewise, much of the waters in northern Mexico have COD contamination problems. For example, 80% of the water in the Baja California river basin region is considered “contaminated” or “highly contaminated” with COD, and 35% of the North Pacific river basin region is considered “contaminated.”

The Mexican states that have good water quality in terms of COD are Nuevo Leon, Tamaulipas, Veracruz and Queretaro. There are 10 states with important problems where average sampling generate results with over 40mg per liter of COD: the Federal District, State of Mexico State (Valley of Mexico and Valley of Toluca), Jalisco, Guanajuato, Baja California, Aguascalientes, Chihuahua, Puebla and Tlaxcala.

We should mention that relative to BOD and TSS, monitoring for this COD indicator has the highest results of “contaminated”and “highly contaminated” representing almost 1/3 of all samples. At the same time, only 28.3% of samples have“excellent” quality while BOD is 41% and SST is 53.5%. Similarly, while the not acceptable (“contaminated” or “highly contaminated”) BOD and TSS levels are 12.5% and 7.5% respectively, the COD level (31%) is 2.5 times higher than BOD levels and 4 times higher than TSS levels. It is easy to see from these figures that COD is more prevalent in water supplies than BOD or TSS and therefore why COD treatment must be a bigger priority in Mexico in the future.

TSS

Concerning TSS monitoring, contrary to the somewhat negative general levels of COD and BOD, only 8% of national waters are considered“contaminated” or “highly contaminated”. Over 50% of the waters tested had“excellent” TSS quality and over 90% are considered“acceptable” or better. Only the Valley of Mexico water basin region presents important TSS problems, with 32% of its waters being considered “contaminated” while only 48% are considered “excellent” or“good”, and only 2/3 reaching the minimum“acceptable” classification. The only state with serious TSS problems, with over 150mg per liter, is Hidalgo. This makes sense since Hidalgo has historically been the recipient of all municipal wastewater from the Valley of Mexico, the one water basin region that has TSS problems.

Distribution Percentage of monitoring locations in surface water by Water Region according to TSS Indicator					
River Basin Regions	**Excellent**	**Good**	**Acceptable**	**Contaminated**	**Heavily**

						Contaminated
I	Baja California Peninsula	68.4	18.5	5.6	5.6	1.9
II	North East	69.4	17.7	4.8	4.8	3.3
III	North Pacific	41.4	36.6	17.1	4.9	0
IV	Balsas	35.6	42.9	14.3	6	1.2
V	South Pacific	32	52	12	4	0
VI	Río Bravo	82.8	12.9	4.3	0	0
VII	North Central Basin	30	40	20	5	5
VIII	Lerma-Santiago-Pacific	35.4	38.4	15.1	7.6	3.5
IX	North Gulf	51.7	31	12.1	5.2	0
X	Central Gulf	72.1	14.8	1.9	9.3	1.9
XI	South Border	69.4	30.6	0	0	0
XII	Yucatán Peninsula	95	5	0	0	0
XIII	Valley of Mexico	24	24	20	32	0
Total		53.5	28.9	10.1	5.9	1.6

Of the rest of the river basin regions, only the Central Gulf (11.2%) and Lerma-Santiago-Pacific (11.1%) have TSS samples that surpass 10%"contaminated" and "highly contaminated" levels. In a real sense, these figures establish that on the national level, of the 3 indicators, TSS is probably the least concern. And, while the Valley of Mexico and Hidalgo are still clear areas for concern, when the Atotonilco wastewater treatment plant comes on line in the near future, it is hoped that these levels, measured following treatment, will drop dramatically.

Mexican Beaches and Water Quality

In the case of the beaches in Mexico, a different classification is used based on the Mexican Health Secretary and World Health Organization standards that classify beaches as suitable for recreational use or not suitable. Those that are suitable have a maximum limit of 200 enterococcus per 100 ml. In 2003, the Clean Beaches Program was created to try and obtain 100% certification of Mexican beaches as suitable for recreational use. The program promotes the sanitation of beaches, basins and aquifers related the beaches. While in 2003, when the program began, only 93% of beaches met this standard, by 2009, this percentage increased to 98%. As a result, while Mexico does not have to target many more beach areas to reach the targeted 100% coverage, its real effort will have to be concentrated on having these beaches continue to meet these levels year in and year out.

Water Quality Problems and their Relation to Wastewater Treatment

In developed countries, wastewaters and surface water sources are generally kept separate. However, Mexico like many other emerging countries has a combined system that presents special challenges to keep the surface sources viable for potable water use. This combined system in Mexico presents Mexico with its greatest water quality challenges in light of the unacceptable current levels of wastewater treatment. Underground and well water quality problems are also serious issues as well but issues for a future article in the Report.

Today, only 30 to 40% of total Mexican wastewater is treated with municipal wastewater treatment somewhere between 35-45% and industrial wastewater treatment below 20%. Only 3 states (Nuevo Leon, Aguascalientes and Baja California) treat 100% of their wastewater and only 1/3 or 10 states treat more than 2/3 of their wastewaters. Of these 10 states, the five that have had important treatment increases are all in the arid north where water is scarce and water reuse is required to meet water supply needs. Another 1/3 or 11 states have treatment between 25 and 65%. The final 1/3 of states treat less than 25% of their municipal wastewaters. In this group, we find the major urban areas of the Federal District (14.4%), the State of Mexico (22.2) and Jalisco (24.1%). In the cases of three somewhat rural states - Hidalgo, Yucatan y Campeche - treatment is below 10%. The low treatment percentage in the state of Hidalgo is somewhat ironic since the Tula Valley in Hidalgo uses more untreated wastewater for agricultural purposes than anywhere else in the world.

There are currently over 2100 municipal wastewater plants and over 2100 industrial wastewater plants in the country. Also, there are regular, annual plans for the construction and rehabilitation of 100-200 treatment plants throughout the country. However, in 2011, 204 municipal wastewater projects were programmed with funding, while only 96 were actually bid and/or executed before the end of the year. Also, the current inventory of municipal plants needs to double and the inventory of industrial plants probably needs to triple before Mexico will be able to adequately address wastewater treatment and therefore surface water contamination issues.

PROSANEAR Program – Part of the Solution

In 2007, the Federal Wastewater Sanitation Program (PROSANEAR) was created. Its purpose was to raise municipal wastewater treatment levels through the forgiveness of fines whereby municipalities would designate fine payment funds to wastewater treatment projects. A similar program exists for companies but its implementation does not have the breadth of the municipal program. The incentives of the program are granted via an establishment and carrying out of a wastewater project action program start to finish with a fully functioning plant. Conagua also offers these municipalities access to 65% federal funding from Apazu and Protar funding authorities. These incentives together with this additional funding made these vital wastewater projects feasible to many tax and money-strapped Mexican municipalities who in many cases could neither afford to pay the fines nor build the plants to eliminate the conditions creating the fines.

In 2008, 46 cities in 11 states participated in PROSANEAR resulting in the cancellation over $5 million US in previous fines for non-treatment. In 2010, as a result of the increase in participation and actual completion of projects, these fine cancellations increased by over 600% representing more than $30 million US. The municipalities that participated in PROSANEAR in

2008 are showed in the below table. We were unable to get a more current listing of those municipalities currently participating in the program.

Municipalities Participating in PROSANEAR (2008)	
State	Municipality
Coahuila de Zaragoza	Matamoros, San Pedro
Hidalgo	Zempoala
Michoacán de Ocampo	Morelia, Uruapan, Jungapeo, Zitacuaro, Pátzcuaro, Zamora, Lázaro Cárdenas, Tlalpujahua
Morelos	Cuernavaca, Ayala, Tétela del Volcán, Emiliano Zapata, Ocuituco, Totolapan, Tlayacapan, Temixco, Zacualpan de Amilpas
Puebla	Atlixco, Cuautlancingo, Tehuacán, Zacatlán, San Salvador El Verde, Xicotepec de Juárez, Venustiano Carranza, San Martín Texmelucan, San Andrés Cholula, Tlatluquitepec, Huauchinango
Querétaro de Arteaga	Amealco de Bonfil, San Juan del Río
San Luís Potosí	San Luis Potosí - Soledad de Graciano Sánchez
Sonora	Cananea, Guaymas, Empalme, Hermosillo, Navojoa
Tamaulipas	Cd. Madero
Tlaxcala	Zacatelco, Tepetitla de Lardizábal, Tenancingo, Xaloztoc, Contra de Juan Cuamatzi, Tetlatlahuaca

In 2009, 143 new municipalities joined the program and 30 municipalities from 2008 continued in the program for a total of 173 municipalities. In 2010, 59 new municipalities were incorporated into the program, while 83 of the 173 participating municipalities finished their projects and obligations resulting in 142 municipal participants in 2010. The states with the largest number of participants in PROSANEAR in 2010 were Michoacan (36) with over 25% of the participants followed by Puebla (20), and Chihuahua (17), Guerrero (13), and the states of Hidalgo, San Luís Potosí, and Tlaxcala (each with 9).

Without a doubt, the lack of monitoring, enforcement, incentives and severe penalties for polluting municipalities and industry contribute greatly to water quality problems in Mexico. Programs like PROSANEAR are excellent initiatives that will help to manage and control water

treatment and water quality. However, in the future, programs like PROSANEAR should not be good options for municipalities, they should be obligatory programs that Conagua can effectively implement and enforce.