Monitoring of metals, organic compounds and coliforms in water catchment points from the Sinos River basin

*Nascimento, CA.[a], Staggemeier, R.[a], Bianchi, E.[a], Rodrigues, MT.[a], Fabres, R.[a], Soliman, MC.[a], Bortoluzzi, M.[a], Luz, RB.[a], Heinzelmann, LS.[a], Santos, EL.[b], Fleck, JD.[a] and Spilki, FR.[a]**

[a]Laboratório de Microbiologia Molecular, Universidade Feevale, Rodovia RS-239, 2755, CEP 93352-000, Novo Hamburgo, RS, Brazil

[b]Departamento de Ensaios e Apoio Laboratorial – DEAL, Companhia Rio-Grandense de Saneamento – CORSAN, Avenida Antônio de Carvalho, 2667, CEP 91430-001, Porto Alegre, RS, Brazil

*e-mail: fernandors@feevale.br

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Abstract

Unplanned use and occupation of the land without respecting its capacity of assimilation and environmental purification leads to the degradation of the environment and of water used for human consumption. Agricultural areas, industrial plants and urban centres developed without planning and the control of effluent discharges are the main causes of water pollution in river basins that receive all the liquid effluents produced in those places. Over the last decades, environmental management has become part of governmental agendas in search of solutions for the preservation of water quality and the restoration of already degraded resources. This study evaluated the conditions of the main watercourse of the Sinos River basin by monitoring the main physical, chemical and microbiological parameters described in the CONAMA Resolution no. 357/2005.The set of parameters evaluated at five catchment points of water human consumption revealed a river that has different characteristics in each reach, as the upper reach was class 1, whereas the middle and lower reaches of the basin were class 4. Monitoring pointed to households as the main sources of pollutants in those reaches, although metals used in the industrial production of the region were found in the samples analyzed.

Keywords: water quality, Sinos River, land usage.

Monitoramento de metais, compostos orgânicos e coliforms em pontos de captação de água da bacia hidrográfica do Rio dos Sinos

Resumo

O uso e ocupação do solo não planejados, sem respeitar sua capacidade de assimilação e de purificação ambiental, levam à degradação do ambiente e da água utilizada para consumo humano. Áreas agrícolas, plantas industriais e centros urbanos desenvolvidos sem planejamento e controle de descargas de efluentes são as principais causas de poluição da água em bacias hidrográficas que recebem todos os efluentes líquidos produzidos naqueles lugares. Nas últimas décadas, gestão ambiental tornou-se parte das agendas governamentais em busca de soluções para a preservação da qualidade da água e a restauração de recursos já degradadas. Este estudo avaliou as condições do curso de água principal da bacia do Rio dos Sinos, monitorando o principal físico, químico e microbiológicos parâmetros descritos na Resolução CONAMA n.º 357/2005. O conjunto de parâmetros avaliados em cinco pontos de captação de água para consumo humano revelou um rio que tem características diferentes em cada alcance, como o superior chegar era classe 1, Considerando que o atinge médio e inferior da bacia foram classe 4. monitoramento apontado famílias como as principais fontes de poluentes naqueles atinge, apesar de metais utilizados na produção industrial da região foram encontrados nas amostras analisadas.

Palavras-chave: qualidade da água, Rio dos Sinos, uso do solo.

1. Introduction

Current water management, although part of governmental agendas, does not necessarily contribute to the reduction of the use of natural resources and their consequent pollution. There has been an increase in the demand of water for production, agriculture and household uses, as well as in the discharge of liquids generated by these processes, which results in substantial environmental costs, such as those to make water potable for human consumption (Fernandes Neto and Sarcinelli, 2009; Pizella and Souza, 2007).

Some of the water degradation factors are canalisation with or without natural diversion and the discharge of industrial and household effluents, in addition to the inadequate use of the soil in rural and urban areas (Pizella and Souza, 2007). According to Fernandes Neto and Sarcinelli (2009), most chemical contaminants in underground and surface waters are associated with industrial and agricultural sources. Such contamination varies along the river course, starting at the preserved areas close to the river source and invariably losing quality downstream, as the river flows through urban or agricultural areas.

Agricultural production technologies, aiming to achieve higher productivity, have undergone important environmental changes, mainly due the introduction of fertilisers and pesticides (Pignati et al., 2007). Pesticides and similar products result from and are included in different processes, and are used in the production, storage and improvement of agricultural practices, pasturelands, the preservation of native or planted forests, urban, hydrologic and industrial environments and other ecosystems, to preserve them from the harmful effects of agents that are noxious to production (Brasil, 1989). In Brazil, 366 active agents for agricultural use are registered. They belong to about 200 chemical groups and are used to produce 1,458 products in the market, most used primarily in monocultures. Herbicides account for 48% of them, and the state of Rio Grande do Sul is the fourth greatest consumer of these products (Conselho em Revista, 2012). Herbicides are chemicals and usually synthetic compounds used to control weeds and increase the productivity of agricultural systems. However, they may be harmful to human and animal life, and may be transported from the soil to waters by surface draining and percolation (Kaufmann et al., 2012).In the state of Rio Grande do Sul, surface water often contain herbicides used in rice paddies (Primel et al., 2005; Sarcinelli, 2005; Bortoluzzi et al., 2006; Fernandes Neto and Sarcinelli, 2009).

Chemical pollutants, such as chromium, lead and nickel, found in surface waters are directly associated with effluent discharges by industrial plants in the river basin. Environmental accidents with chemicals, which contaminate rivers, are common and often affect public water supply in cities. In addition, agricultural and industrial pollution, treated or untreated household effluent discharges also contribute to the increase of BOD_{5-20}, phosphorus and microorganisms, as well as of nitrogen in its different forms. BOD_{5-20}, nitrogen and phosphorus from household sewage are pollutants for which a daily amount eliminated per person has been determined (Gonçalves and Souza, 1997; Von Sperling, 2002) and, therefore, are easily estimated, differently from the estimation of the amount of chemical pollutants, which are invariably associated with the industrial and agricultural production in any river basin.

To ensure water potability for human consumption, it is necessary to treat water. The purpose of treatment is to remove or inactivate chemicals and pathogens that may pose risks to human health, as well as to meet organoleptic standards (Daniel and Cabral, 2011). In Brazil, the basic processes used to treat water for human consumption have been the same since the beginning of the 20th century. Treatment started in Porto Alegre in 1924, followed by São Paulo in 1929 and Campinas in 1934, with the installation of rapid filtration systems. Rio de Janeiro did not have water treatment before 1955 (Richter and Azevedo-Neto, 1991). To achieve the water quality desired for human consumption, nations have developed and enforced laws, decrees and ordinances that define the maximum amount of different known chemical pollutants and microorganisms that indicate fecal pollution in raw and treated water. Therefore, monitoring is essential to control the water provided to the population which makes prevention a challenge to sanitation specialists (Carmo et al., 2008)

Over the last decades, Brazil has defined public policies to establish standards and monitoring, which has contributed to the improvement in this area. The Brazilian government, represented by the *ConselhoNacional de MeioAmbiente* (CONAMA [National Environment Council]), has an important presence in environmental preservation. Some examples are the several ordinances issued by CONAMA to regulate environmental water management (Brasil, 1997; Brasil, 2005; Brasil 2011) and the governmental programs that grant resources for basic sanitation and sewerage systems (Brasil 2001).

In the Sinos River basins, water resources are intensely polluted, theoretically explained by the presence of three main components defined according to the uses of land along the basin. In the upper reach, there is intensive expansion of rice cultivation and its consequent effects on water availability and the discharge of chemical contaminants found in agrochemical products. In the middle reach, there are initial contributions of rural and urban land use in the form of diffuse and local contamination by animal feces and untreated urban sewage, a factor that is worse and adds up to industrial contamination in the lower third of the Sinos River, which is densely populated and has very little sewage treatment (Brasil, 2009).

The Sinos River basin has ten water treatment plants, seven in the main river of the basin, which supply fifteen cities in the region. Of these plants, three use a compact treatment system and eight use conventional water treatments, while one has both systems working in parallel. This study evaluated a set of physical, chemical and microbiological parameters in July 2011 and June 2012, at five points where water is collected for human consumptions in the principal river of the basin. These catchment points are operated by CORSAN, the water company in the region, and include the cities of Santo Antônio da Patrulha (upper reach), Taquara and Campo Bom (middle reach) and Esteio and Nova Santa Rita (lower reach). These plants distribute treated water for the population of 12 cities. Monitoring results were compared with those presented in CONAMA Resolution no. 357 of 2005 and evaluated the physical, chemical and microbiological risks of the water from these points for human health.

2. Material and Methods

2.1. Study sites

The catchment points of water for human consumption evaluated in this study are described in Figure 1. Samples were collected from July 2011 to June 2012.

2.2. Physical and chemical tests

Samples were collected at the point where untreated water arrived at each of the treatment plants under monitoring. All samples were placed in ice boxes. Analyses of the untreated waters were conducted by the Companhia Rio-grandense de Saneamento do Estado do Rio Grande do Sul (CORSAN) according to the 2nd edition of the Standards for Examination of Water and Wastewater of the American Water Works Association (AWWA).

2.3. Coliform counting

Most probable numbers (MPN) of thermotolerant coliforms were defined using an enzyme substrate method (Colilertt®) in the Laboratório de Microbiologia Molecular of Universidade Feevale.

3. Results and Discussion

The classification of the sites under monitoring was based on CONAMA Resolution no. 237/2005 (Brasil, 2005). Tables 1, 2, 3, 4 and 5 show the classification of the Sinos River waters at the sampling sites and identifies their different classes. The evaluation of data revealed that the river was class 4 in 8% (one sample) of the time in site 1 (Santo Antonio da Patrulha) and in site 2 (Taquara), 16% (two samples) of the time; while in site 3 (Campo Bom), 100% (10 samples) of the time in site 4 (Esteio), and 88% (9 samples) of the time in site 5 (Nova Santa Rita). According to current Brazilian federal regulations, sites 3, 4 and 5 were classified as 4 and were, thus, inadequate for catchment of water for human consumption.

Sites 1 and 2 were class 4 in one of the samplings; the limiting parameter, in the two sites, was the number of thermotolerant coliforms, which, according to legislation, should be greater than 20% of the time to change classification.Therefore, the water collected in sites 1 and 2 was acceptable (class 1) for human consumption after simplified treatment, used in the two water treatment plants of the city of Santo Antônio da Patrulha (compact treatment system) and Taquara (conventional treatment system).

Sites 3, 4 and 5 were class 4 and, therefore, according to legislation, improper for human use. Although their classification indicated that the river should not be used as a source of water for human consumption, some of the parameters, such as dissolved oxygen, biochemical oxygen demand, total phosphorus and total oxygen, which limit water use, are not fundamentally important to classify water for human consumption. These parameters are associated with the preservation of aquatic life in watercourses, and current water treatment technology used in treatment plants at these catchment points is efficient to purify water according to potability parameters defined by the legislation on water quality for human consumption.

The results of this study revealed that all catchment points were safe in terms of human health when considering the limits defined by Brazilian norms, and suggested that the main polluting agent of the water of the Sinos River basins was household sewage, as no metals and pesticides were above the limits of the CONAMA Resolution no. 357/2005. Although there are large areas of rice paddies in the area, no residues were detected during the study time (Pignati et al., 2007). The presence of thermotolerant coliforms is not conclusive evidence that the greatest contribution to pollution at these sites is made by untreated household sewage, as this parameter indicates the presence of feces of warm blood animals. It is not possible to track the source of this pollution, which may also be associated with the economic activity in the region of Santo Antônio da Patrulha, Rolante and Taquara, where meat and dairy cattle are raised (Schulz and Martins-Junior, 2001).

Household pollution in the middle and lower reaches of the river (sites 3, 4 and 5) confirmed data in the 2009 ANA

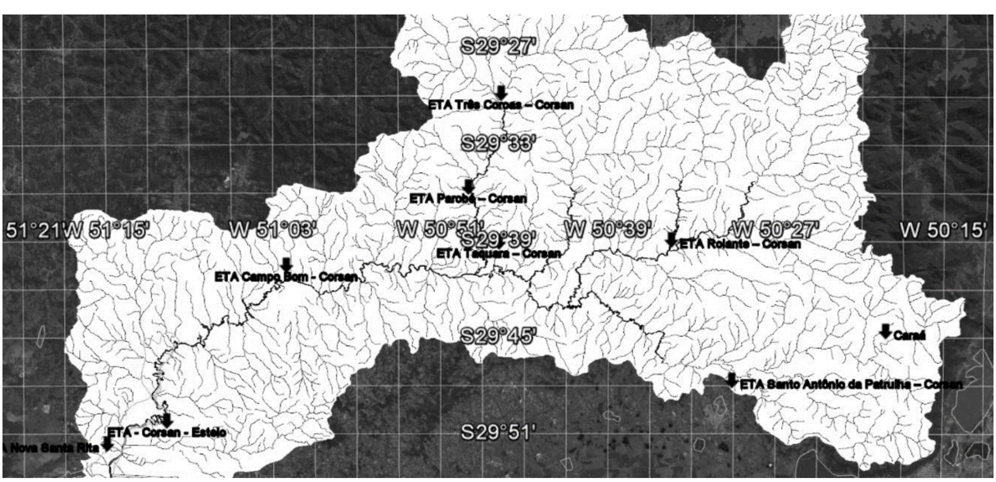

Figure 1. Sinos River basin and diagram of the main watercourses and geographic location of sampling sites (arrows).

Table 1. Results for the Sinos River at the site in the city of Santo Antonio da Patrulha (S1) during monitoring.

Parameter	Sampling month											
	07	08	09	10	11	12	01	02	03	04	05	06
BOD 5-20		1	1	1		1	1		1	1	1	1
Dissolved oxygen		1	1	1		3	1		1	1	1	1
Total nitrogen		1	1	1		1	1		1	1	1	1
Nitrite		1	1	1		1	1		1	1	1	1
Nitrate		1	1	1		1	1		1	1	1	1
Total phosphorus		1	1	1		1	1		1	1	1	1
Manganese		1	1	1		1	1		1	1	1	1
Barium		1	1	1		1	1		1	1	1	1
Chromium		1	1	1		1	1		1	1	1	1
Hexavalent chromium		1	1	1		1	1		1	1	1	1
Cadmium		1	1	1		1	1		1	1	1	1
Zinc		1	1	1		1	1		1	1	1	1
Tetrachloroethane		1	1	1		1	1		1	1	1	1
Toluene		1	1	1		1	1		1	1	1	1
Dichloromethane		1	1	1		1	1		1	1	1	1
Dichloroethane		1	1	1		1	1		1	1	1	1
Thermotolerant coliforms	1	4	1	1	1	1	1		1	1	1	1
***Other parameters**		1	1	1		1	1		1	1	1	1

*Ammonium, total arsenic, total lead, total copper, total mercury, total nickel, total selenium, total zinc, chlorides, phenols, odor, pH, total solids, 1,1-dichloroethane, 1,2-dichloroethane, chloroform, trichloroethane.Bromodichloroethane, dibromochloroethane, benzene, carbon tetrachloride, orto-, meta- and para-xylene,vinyl chloride, monochlorobenzene, ethyl benzene, bromoform, THM, hexachlorobenzene, simazine, atrazine, lindane (yBHC), propanyl, heptachlor, heptachlor epoxide, aldrin/dieldrin, alpha- and beta- endosulfan and endosulfan sulfate, endrin, DDT (o.p'-DDT and p.p'-DDT), methoxychlor, alpha-, gamma-chlordane (t-nonachlor), molinate, alachlor, methlachlor, pendimethaline, cis- and trans-permetrine, benzo(a)pyrene, 2,4,6-trichlorophenol, 2,4-D, pentachlorophenol, bentazone, trifluraline, glyphosate + AMPA.Benzo(a)pyrene is an aromatic polycyclic hydrocarbons. 2,4,6-trichlorophenol is a phenolic compound.

Table 2. Results for the Sinos River at the site in the city of Taquara (S2) during monitoring.

Parameter*	Sampling month											
	07	08	09	10	11	12	01	02	03	04	05	06
BOD 5-20	1	1	1	1		1	1	1	1	1	1	1
Dissolved oxygen	1	1	1	1		1	1	1	1	1	1	1
Total nitrogen	1	1	1	1		1	1	1	1	1	1	1
Nitrite	1	1	1	1		1	1	1	1	1	1	1
Nitrate	1	1	1	1		1	1	1	1	1	1	1
Total phosphorus	1	1	1	1		1	1	1	1	1	1	1
Manganese	1	1	1	1		1	1	1	1	1	1	1
Barium	1	1	1	1		1	1	1	1	1	1	1
Chromium	1	1	1	1		1	1	1	1	1	1	1
Hexavalent chromium	1	1	1	1		1	1	1	1	1	1	1
Cadmium	1	1	1	1		1	1	1	1	1	1	1
Zinc	1	1	1	1		1	1	1	1	1	1	1
Tetrachloroethane	1	1	1	1		1	1	1	1	1	1	1
Toluene	1	1	1	1		1	1	1	1	1	1	1
Dichloromethane	1	1	1	1		1	1	1	1	1	1	1
Dichloroethane	1	1	1	1		1	1	1	1	1	1	1
Thermotolerant coliforms	4	1	3	2		1	3	2	1	1	1	2
***Other parameters**	1	1	1	1		1	1	1	1	1	1	1

*Ammonium, total arsenic, total lead, total copper, total mercury, total nickel, total selenium, total zinc, chlorides, phenols, odor, pH, total solids, 1,1-dichloroethane, 1,2-dichloroethane, chloroform, trichloroethane.Bromodichloroethane, dibromochloroethane, benzene, carbon tetrachloride, orto-, meta- and para-xylene,vinyl chloride, monochlorobenzene, ethyl benzene, bromoform, THM, hexachlorobenzene, simazine, atrazine, lindane (yBHC), propanyl, heptachlor, heptachlor epoxide, aldrin/dieldrin, alpha- and beta- endosulfan and endosulfan sulfate, endrin, DDT (o.p'-DDT and p.p'-DDT), methoxychlor, alpha-, gamma-chlordane (t-nonachlor), molinate, alachlor, methlachlor, pendimethaline, cis- and trans-permetrine, benzo(a)pyrene, 2,4,6-trichlorophenol, 2,4-D, pentachlorophenol, bentazone, trifluraline, glyphosate + AMPA.Benzo(a)pyrene is an aromatic polycyclic hydrocarbons. 2,4,6-trichlorophenol is a phenolic compound.

Table 3. Results for the Sinos River at the site in the city of Campo Bom (S3) during monitoring.

Parameter*	Sampling month											
	07	08	09	10	11	12	01	02	03	04	05	06
BOD 5-20	1	1	1	1		2	3	1	1		1	1
Dissolved oxygen	1	2	1	3		4	4	2	2		2	3
Total nitrogen	1	1	3	1		4	4	1	1		1	1
Nitrite	1	1	1	1		1	1	1	1		1	1
Nitrate	1	1	1	1		1	1	1	1		1	1
Total phosphorus	1	1	1	1		3	3	3	3		4	4
Manganese	1	1	1	3		3	3	1	3		1	1
Barium	1	1	1	1		1	1	1	1		1	1
Chromium	1	1	1	1		1	1	1	1		1	1
Hexavalent chromium	1	1	1	1		1	1	1	1		1	1
Cadmium	1	1	1	1		1	1	1	1		1	1
Zinc	1	1	1	1		1	1	1	1		1	1
Tetrachloroethane	1	1	1	1		1	1	1	1		1	1
Toluene	1	1	1	1		1	1	1	1		1	1
Dichloromethane	1	1	1	1		1	1	1	1		1	1
Dichloroethane	1	1	1	1		1	1	1	1		1	1
Thermotolerant coliforms	2	1	3	3	1	1	2	2	3	3	3	2
***Other parameters**	1	1	1	1		1	1	1	1		1	1

*Ammonium, total arsenic, total lead, total copper, total mercury, total nickel, total selenium, total zinc, chlorides, phenols, odor, pH, total solids, 1,1-dichloroethane, 1,2-dichloroethane, chloroform, trichloroethane.Bromodichloroethane, dibromochloroethane, benzene, carbon tetrachloride, orto-, meta- and para-xylene,vinyl chloride, monochlorobenzene, ethyl benzene, bromoform, THM, hexachlorobenzene, simazine, atrazine, lindane (yBHC), propanyl, heptachlor, heptachlor epoxide, aldrin/dieldrin, alpha- and beta- endosulfan and endosulfan sulfate, endrin, DDT (o.p'-DDT and p.p'-DDT), methoxychlor, alpha-, gamma-chlordane (t-nonachlor), molinate, alachlor, methlachlor, pendimethaline, cis- and trans-permetrine, benzo(a)pyrene, 2,4,6-trichlorophenol, 2,4-D, pentachlorophenol, bentazone, trifluraline, glyphosate + AMPA.Benzo(a)pyrene is an aromatic polycyclic hydrocarbons. 2,4,6-trichlorophenol is a phenolic compound.

Table 4. Results for the Sinos River at the site in the city of Esteio (S4) during monitoring.

Parameter*	Sampling month											
	07	08	09	10	11	12	01	02	03	04	05	06
BOD 5-20			1	3		3	4	2		3	4	1
Dissolved oxygen			4	4		4	4	4		4	4	3
Total nitrogen			1	1		4	3	1		3	4	4
Nitrite			1	1		1	1	1		1	1	1
Nitrate			1	1		1	1	1		1	1	1
Total phosphorus			4	4		4	4	4		4	4	4
Manganese			3	3		3	3	3		3	3	3
Barium			1	1		1	1	1		1	1	1
Chromium			1	1		1	1	1		1	1	1
Hexavalent chromium			1	1		1	1	1		1	1	1
Cadmium			1	1		1	1	1		1	1	1
Zinc			1	1		1	1	1		1	1	1
Tetrachloroethane			1	1		1	1	1		1	1	1
Toluene			1	1		1	1	1		1	1	1
Dichloromethane			1	1		1	1	1		1	1	1
Dichloroethane			1	1		1	1	1		1	1	1
Thermotolerant coliforms	3	4	1	3	1	2	2	3		3	4	3
***Other parameters**			1	1		1	1	1		1	1	1

*Ammonium, total arsenic, total lead, total copper, total mercury, total nickel, total selenium, total zinc, chlorides, phenols, odor, pH, total solids, 1,1-dichloroethane, 1,2-dichloroethane, chloroform, trichloroethane.Bromodichloroethane, dibromochloroethane, benzene, carbon tetrachloride, orto-, meta- and para-xylene,vinyl chloride, monochlorobenzene, ethyl benzene, bromoform, THM, hexachlorobenzene, simazine, atrazine, lindane (yBHC), propanyl, heptachlor, heptachlor epoxide, aldrin/dieldrin, alpha- and beta- endosulfan and endosulfan sulfate, endrin, DDT (o.p'-DDT and p.p'-DDT), methoxychlor, alpha-, gamma-chlordane (t-nonachlor), molinate, alachlor, methlachlor, pendimethaline, cis- and trans-permetrine, benzo(a)pyrene, 2,4,6-trichlorophenol, 2,4-D, pentachlorophenol, bentazone, trifluraline, glyphosate + AMPA.Benzo(a)pyrene is an aromatic polycyclic hydrocarbons. 2,4,6-trichlorophenol is a phenolic compound.

Table 5. Results for the Sinos River at the site in the city of Nova Santa Rita (S5) during monitoring.

Parameter*	Sampling month											
	07	08	09	10	11	12	01	02	03	04	05	06
BOD 5-20			1	1		3	3	2	3	3	3	1
Dissolved oxygen			4	4		4	1	4	4	4	4	4
Total nitrogen			1	1		4	3	1	3	3	4	3
Nitrite			1	1		1	1	1	1	1	1	1
Nitrate			1	1		1	1	1	1	1	1	1
Total phosphorus			3	3		4	4	4	4	4	4	4
Manganese			1	1		3	3	3	3	3	3	3
Barium			1	1		1	1	1	1	1	1	1
Chromium			1	1		1	1	1	1	1	1	1
Hexavalent chromium			1	1		1	1	1	1	1	1	1
Cadmium			1	1		1	1	1	1	1	1	1
Zinc			1	1		1	1	1	1	1	1	1
Tetrachloroethane			1	1		1	1	1	1	1	1	1
Toluene			1	1		1	1	1	1	1	1	1
Dichloromethane			1	1		1	1	1	1	1	1	1
Dichloroethane			1	1		1	1	1	1	1	1	1
Thermotolerant coliforms	1		4	3	1	2	1		2	2	2	
***Other parameters**			1	1		1	1	1	1	1	1	1

*Ammonium, total arsenic, total lead, total copper, total mercury, total nickel, total selenium, total zinc, chlorides, phenols, odor, pH, total solids, 1,1-dichloroethane, 1,2-dichloroethane, chloroform, trichloroethane.Bromodichloroethane, dibromochloroethane, benzene, carbon tetrachloride, orto-, meta- and para-xylene,vinyl chloride, monochlorobenzene, ethyl benzene, bromoform, THM, hexachlorobenzene, simazine, atrazine, lindane (yBHC), propanyl, heptachlor, heptachlor epoxide, aldrin/dieldrin, alpha- and beta- endosulfan and endosulfan sulfate, endrin, DDT (o.p'-DDT and p.p'-DDT), methoxychlor, alpha-, gamma-chlordane (t-nonachlor), molinate, alachlor, methlachlor, pendimethaline, cis- and trans-permetrine, benzo(a)pyrene, 2,4,6-trichlorophenol, 2,4-D, pentachlorophenol, bentazone, trifluraline, glyphosate + AMPA.Benzo(a)pyrene is an aromatic polycyclic hydrocarbons. 2,4,6-trichlorophenol is a phenolic compound.

report (Brasil, 2009). Intense human occupation at these sites and the lack of household effluent treatment was confirmed by the results of total nitrogen, total phosphorus, high biochemical oxygen demand and low oxygen content. Industrial pollution was confirmed by total chromium and total barium values, but the amount of these metals were below the maximum allowed for class 1 during all the monitoring time, which was a sign of the efficiency of effluent treatment conducted by the companies in the basin and of a correct licensing system and environmental control in the region.

CONAMA Resolution no 357, issued on March 17, 2005, defines the guidelines for the management of water quality in Brazil. This country, due to its large size, has diverse geomorphological and climatic characteristics and different production matrices in its several river basins. The enforcement of this legislation, without a systemic vision, does not efficiently contribute to water management in terms of the different uses of water (Brasil, 2009).

According to Schulz and Martins-Junior (2001), heavy metals from metallurgy and tanneries raise concerns, although a study of the Sinos River waters in the city of Novo Hamburgo conducted by Nascimento and Naime (2009) did not find any contamination by total chromium, nickel or lead in the samples analysed, differently from findings reported by Robaina et al. (2002), who found lead, chromium and nickel in sediments of streams that flow into the Sinos River.Another study, conducted in 2007 and 2008 in four sites of the basin, found that the Sinos River was not proper for water catchment for human consumption, according to CONAMA Resolution no. 357, in the lower basin reach (Blume et al, 2010).

The quality of the Sinos River water and the search for solutions to improve the environment in this basin have been discussed by a committee of legislative representatives in the state of Rio Grande do Sul, organised for this sole purpose, as well as by a committee for the river basin (*COMITESINOS*) and a consortium of counties to protect the Sinos River (*Consórcio de Municípios Pró-Sinos*). However, water quality parameters at the points where water is collected for human consumption, defined in current legislation, have never been defined or described collectively. This discussion has been based on the 2009 Brazilian National Water Agency (*Agência Nacional de Águas*) report, which described the Sinos as a river with a high organic load associated with an elevated population density in metropolitan areas (Brasil, 2009).

The analysis of physical, chemical and microbiological data alone is not enough for decision making, and evaluations should also take into consideration river flow rates, as well as several emergent organisms and organic pollutants. The definition of a reference flow rate is essential for the continuous improvement of water management in the Sinos River basin.

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