International Journal of Latest Research in Science and Technology **ISSN (Online):2278-5299**
Volume 2, Issue 6: Page No.32-37, November-December 2013
https://www.mnkpublication.com/journal/ijlrst/index.php

COMPARATIVE ANALYSIS ON THE LEGISLATIVE REQUIREMENTS OF WASTEWATER DISPOSAL IN WATER BODIES FOR AFRICA AND NORTH AMERICA

[1]Mircea-Vlad Mureșan,[1]Marius-Daniel Roman, [1]Elena Maria Pică

[1]Technical University of Cluj-Napoca -UTCN, Romania

Abstract -Water is a common asset of the planet, and every country has the obligation to protect the water from the effects of pollution for the good of the entire mankind. The importance of water for the environment has become a major component of the laws of every country. This article makes a comparative analysis of water protection standards in terms of legislative requirements regarding the discharge of the domestic wastewaters into the water bodies. For these purposes, the legislative discharge frameworks of several countries on two continents are compared: Uganda, Kenya and Tanzania on the African continent, respectively the United States of America on the North America continent.

Keywords - discharging standards, wastewater, water bodies, Africa, SUA.

I. INTRODUCTION

For the operation and acceptance of any State, it must observe the legislative frames imposed by the international and national forums. The purposes of the provisions of the legislative frameworks in terms of treatment of domestic wastewaters refer to the protection of the environment against its deterioration, the setting of the general conditions of purification and evacuation, as well as of the allowed limit values of the main quality indicators of these waters.

We notice that some countries from various continents are monitoring approximately the same parameters of the domestic wastewaters discharged in emissaries, but they have different accepted limit values of these parameters [1]. The future challenges involve the harmonization of the standards at global and continental level, and a minimum level of discharge requirements applies to all the countries. This harmonization of the standards will create a legal frame for the sustainable management and monitoring of the discharged effluents to improve, at the global scale, the quality of the water courses and to make sure that the ecosystems are preserved by a healthy environment.

II. MATERIALS AND METHODS

This study is destined to the research of the current stage of the international legislation as regards the discharge standards of pollutants into water bodies. To have an overall image concerning the legislative norms and the mini-mum values of effluent quality demanded, the legislative documents concerning the treatment of domestic wastewaters on two continents will be analyzed, respectively North America and Africa. The discharge conditions are analyzed according to the main pollution parameters, namely the Five-day Biochemical Oxygen Demand (BOD_5), the Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Nitrogen (TN) and Total Phosphorus (TP).

Study in Africa area

It is assumed that, over the next 20 years, Africa's urban population will double. At 3.9 percent per year, urban population growth rates in Africa have been and will continue to be the highest in the world. Currently about 320 million Africans (37 percent of the population) live in urban areas, more than twice as many as in 1990. By 2030, Africa's urban population is forecast to rise to almost 50 percent of the population, or some 654 million people. To put it another way, half the people who will be living in African cities 20 years from now have yet to arrive: now is the time for city planners to prepare for their arrival [2].

In 2010, only 61 percent of Africans had access to clean water and 31 percent to adequate sanitation. In urban areas, the situation is slightly better, with 83 percent access to water and 43 percent access to sanitation [2]. Between 2000 and 2010, 84 million urban Africans gained access to improved water supply and 42 million to improved sanitation. This is an impressive 3.9 percent increase of the population with access to the water supply and sanitation infrastructure over the last decade, but it is cancelled by the 3.9 percent of growth rate of the urban population.

Thus, the proportion of urban dwellers with access to water and sanitation services remained static, Table 1.

Publication History
Manuscript Received : 24 December 2013
Manuscript Accepted : 28 December 2013
Revision Received : 29 December 2013
Manuscript Published : 31 December 2013

TABLE 1 URBAN POPULATION WITH ACCESS TO WATER SUPPLY AND SANITATION 2000 AND 2010 (IN THOUSANDS PEOPLE) [1]

	Year	Urban Improved		National Improved	
		[number]	[%]	[number]	[%]
Drinking Water	2000	179,482	82	367,661	55
	2010	263,195	83	524,264	61
Sanitation facilities	2000	92,917	43	185,808	28
	2010	135,402	43	261,505	31

Although the efforts to improve and build water supply and sanitation systems of the last decades are remarkable, they must be sped up to be able to fulfil the objectives set by Millennium Development Goal (MDG) for sewage systems [3].

In most African countries, only the rich are connected to water and sanitation networks. Tariffs that fully recover capital costs would be affordable for only half of the population in Africa. Poor people currently pay many times the official water tariffs, as they buy their water from private providers. Thus, the access to water and sanitation systems is unfair, since they are available only for dwellers with incomes above the average, while the poor are using untreated water sources and traditional latrines [3].

A little less than half of the households supplied with drinking water have restrooms, which are connected rather to septic tanks than to sewage systems. Namibia, Senegal and South Africa report a total coverage with sewage systems, but in most African countries, the sewage facilities serve less than 10% of urban areas [3].

Only a small proportion of wastewater is collected, and an even smaller fraction is treated. Except cities in South Africa, only a few African localities have operational wastewater treatment plants. For instance, in Angola, the city Luanda, with a population of over 4 million inhabitants, discharge the entire collected wastewater into the Atlantic Ocean, without treating it. Harare, a city in Zimbabwe, had a relatively high level of wastewater treatment 15 years ago, but now it is estimated that only 5 percent of the wastewater produced is treated. Even in South Africa, of the 1,600 treatment plants operating, only 60% meet the discharge requirements into water bodies [2].

Uganda

By Uganda's Constitution (1995) and by the National Water Politics (1999), water is acknowledged as an economic and social asset. The National Environmental Act (1995) provides a legal framework for sustainable environmental management and specifically sets water quality and use standards. Further, the Water Act (1995) provides legal framework for the rational management and use of national waters, as well as providing for pollution control and promotion of safe disposal of wastewater. The relevant regulation for wastewater discharge is vested in the National Environment Regulation SI No 5/1999 [4].

The effluents standards in Uganda are established by the Uganda Bureau of Standards and implemented by the National Environment Management Authority (NEMA). The control of the discharges of wastewaters into the environment, including the executive power to issue, renew or cancel permits to discharge pollutants into water bodies are delegated by NEMA to the Water Development Management. The control and monitoring of pollution or the establishment of environmental standards require local institutions for an efficient management.

The bacterial contamination due to poor sanitation facilities is by far the most critical water quality problem for surface water in Uganda. Also, there is further evidence of eutrophication of surface waters often seen in Lake Victoria [4].

The monitored pollution parameters and their limit concentrations of the domestic wastewaters discharged into the environment are stipulated in the "National Environmental Regulation (Effluent Discharge Standards in Water or on Ground) S.I. No 5/1999". The allowed limits values of the main pollutants are shown in Table 2.

TABLE 2DISCHARGING CONDITIONS FOR TREATED WASTEWATER IN UGANDA [5]

Marker	Discharge to water bodies [mg/l]
BOD_5	50
COD	100
TSS	100
TN	10
TP	10

Kenya

In Kenya, the Bureau of Standards is responsible for setting standards in the water field, including those for water quality and effluents regulation. The Sessional Paper no. 1 of 1999, outlines the government's specific objectives, among which is the supply of good quality water in sufficient quantities and quality to meet the various water needs, while ensuring safe disposal of wastewater and environmental protection. Moreover, the interdependence between the water supply and the discharge of domestic wastewater is acknowledged. The Water Resource Management Authority is the management agency that manages water resources, suing control plans to discharge domestic wastewaters [4].

Currently, Kenya has two vital standards for regulating effluent discharges, which are classified depending on whether the effluents are discharged into sewage systems or into emissaries. They are drafted by the Technical Wastewater Committee under the supervision of the Standardization Committee. The standard regulating the allowed limit concentration of pollutants in domestic wastewaters dischargeable into emissaries is KS 1966-1:2007, and the one establishing the allowed limit concentration of the pollutants discharged into the public sewage system is KS 1966-2:2007 [4].

The allowed limit values for the main pollutants are shown

in Table 3.

TABLE 3DISCHARGING CONDITIONS FOR TREATED WASTEWATER IN KENYA [4]

Marker	Discharge to water bodies [mg/l]
BOD_5	50
COD	250
TSS	50
TN	50
TP	6

Tanzania

In Tanzania, the Ministry of water and the Ministry of Industry and Trade manage a well-coordinated sector by applying the Water Sector Development Plan. The responsibility to serve the population is delegated to the regional authorities and to the water service providers. The Bureau of Standards is responsible for setting the requirements, including the quality of water and of the discharged effluents. This bureau collects different standards to constitute the National Environmental Standards Compendium. The Environmental Management Act 2004 provides the executor instruments to apply the legislation specific to water. The standards on effluents are regulated by the Environmental National Administration Council.

In Tanzania, to make sure that the effluent discharge standards are applied, the Water Resources Management Act of 2009 has established several classifications to determine the relevant pollution control standard applied for various types of pollutants. The different discharge standards are applied depending on the category of water use of the water courses, composition of pollutants, origin of pollutants, and the direct or indirect discharge into emissaries [4].

For instance, there are different standards of application to discharge pollutants into the sewage system or directly into the water bodies. It is not allowed to discharge the pollutants resulting from industry or trade into the natural environment without the guaranteed acceptance of the water Officer, and the public has the right to oppose to the granting of this consent. Also, no discharge of industry and trade wastewaters is allowed within 230 m of a borehole, lake or other type of water course [4].

The allowed limit values for the main pollutants are shown in Table 4.

TABLE 4DISCHARGING CONDITIONS FOR TREATED WASTEWATER IN TANZANIA [6]

Marker	Discharge to water bodies [mg/l]
BOD_5	30
COD	60
TSS	100
TN	15
TP	6

Study in North America area

In the United States of America, the law governing the water sector is the Water Quality Act (WQA), given in 1965. This law created the Federal Water Pollution Control Administration (FWPCA), which represented a major regulatory advancement in water pollution control by requiring states to develop water quality standards for inter-state waters by 1967.

Growing concern about the environment prompted President Nixon to form the U.S. Environmental Protection Agency (EPA) in 1970 to consolidate federal pollution control activities. EPA's objective was to draft the standards on effluent quality. To discharge the domestic wastewater into emissaries, it is necessary to apply for the discharge permit, and the Engineer Army Corps (EAC) would ask EPA if the proposed effluent levels were consonant with state water quality standards and with the newly developed standards on effluent quality.

EPA tried to establish national standards, even limitations at national level for wastewater pollutants, as basis to set the technological capacities. The first standards focused on conventional pollutants, which were generally produced by households, trade and industry, such as BOD_5, TSS, pH, fecal coliforms, oils and grease. Later, the list of pollutants that must be controlled before discharging into the territorial waters has been extended, by adding toxic pollutants, most of them originating from industry and numbering about 126.

Since EPA is a federal agency, it authorizes the local States or governments to implement the National Pollutant Discharge Elimination System (NPDES)program by issuing discharge permits.

The discharge permits include the discharge requirements for various pollutants, and they are set following an assessment where various factors are outlined. The main factors taken into account are the pollutant toxicity potential, the volume of discharged wastewaters (implicitly the number of equivalent inhabitants), the impact on the public health, the quality of the water bodies and the distance from the coast waters [8].

WQAsection 304(d) required EPA to publish information on the degree of effluent reduction attainable through the application of secondary treatment. Every city treatment plant must mandatorily satisfy the quality standards for secondary treatment or technologies equivalent the secondary treatment standards. The secondary stage standards are based on the assessment of the performances of a mechanical and biological treatment to remove BOD_5 and TSS. In Table 5, the allowed limit values achieved by the secondary treatment stage are specified.

TABLE 5 SECONDARY TREATMENT STANDARDS [9]

Parameter	30-day average	7-day average
BOD_5	30 mg/l	45 mg/l
TSS	30 mg/l	45 mg/l
BOD_5 and TSS removal	not less than 85%	-

(concentration)		
pH	within the limits of 6 - 9	

In accordance with the regulations set by EPA, states can adjust the maximum allowable TSS concentration for waste stabilization ponds and constructed wetlands [9], by setting higher concentrations than those stipulated for secondary stage alternative technologies. In the EPA regulation, section 133.103(c), is defined the TSS concentration achieved using the stabilization ponds as being the allowed concentration reached at 90% of the operating time, provided that the maximum allowed concentration for BOD_5 is satisfied.

In Table 6 are summarized the TSS concentrations maximum allowed in effluents, accepted by EPA for various states.

TABLE 6STATE SPECIFIC ADJUSTED TSS REQUIREMENTS [7]

State	Alternate TSS limitation [mg/l]	State	Alternate TSS limitation [mg/l]
Alabama	90	Nebraska	80
Alaska	70	North Carolina	90
Arizona	90	Nevada	90
Arkansas	90	New Hampshire	45
California	95	New Mexico	90
Georgia	90	New York	70
Illinois	37	Ohio	65
Indiana	70	Oklahoma	90
Iowa	80	Rhode Island	45
Louisiana	90	South Carolina	90
Maine	45	South Dakota	120
Maryland	90	Tennessee	100
Michigan summer	70	Texas	90
Michigan winter	40	Vermont	55
Minnesota	40	Washington	75
Missouri	80	Wisconsin	80
Montana	100	Wyoming	100

In some states, water quality standards allow the consideration of mixing of effluent with the emissary in order to establish the discharge requirements. Depending on the state's water quality standards and implementation policy, such a mixing consideration could be expressed in the form of a dilution allowance or regulatory mixing zone. The accepted dilution or the allowed mixing zone is a limited area or volume of water where the effluent flow is mixed with the water course flow, and where the water quality standards are allowed to be exceeded. Thus, where dilution is allowed to be considered, the emissary quality standards may be satisfied at a certain distance from the discharge point, otherwise they must be met at the discharge point, more precisely at the end of the discharge pipe.

In Table 7 are shown the reference values for the discharge of various pollutants into the water courses [11].

TABLE 7DISCHARGING CONDITIONS FOR TREATED WASTEWATER IN SUA [11]

Marker	Discharge to water bodies [mg/l]
BOD_5	30
COD	120
TSS	100
TN	2
TP	14

III. RESULTS AND DISCUSSION

Analyzing the technical norms concerning the establishment of pollutant charging limits of wastewaters on the discharge into natural receivers on the two continents, we notice major differences between the imposed values.

In terms of BOD_5, Uganda and Kenya have the same allowed limit values of 50 mg/l, while Tanzania and USA have lower allowed limit values of 30 mg/l, Fig. 1. Thus, we notice that USA's and Tanzania's financial efforts to reduce BOD_5 are 40% bigger than Uganda's and Kenya's.

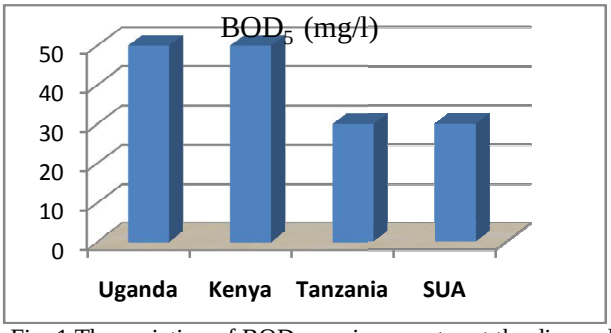

Fig. 1 The variation of BOD_5 maximum rates at the disposal in water bodies

Comparing the maximum concentrations allowed on discharge, in terms of COD, Fig. 2, Kenya shows the highest value, of 250 mg/l COD on discharge. The strictest legislation belongs to Tanzania, accepting concentrations of only 60 mg/l COD, followed by Uganda, 100 mg/l, respectively USA, 120 mg/l.

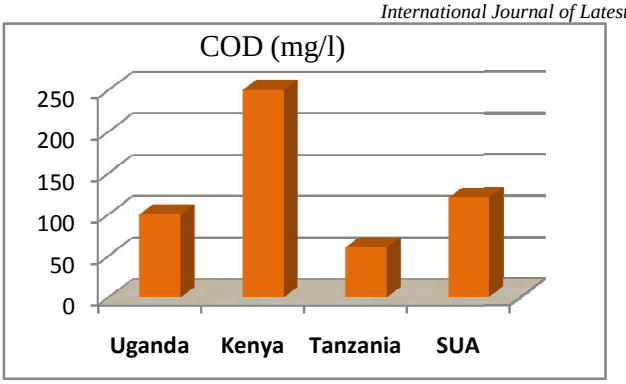

Fig. 2 The variation of COD maximum rates at the disposal in water bodies

Noticing the limit values imposed on the discharge of domestic wastewaters into the natural environment, in terms of TN, Fig. 3, Kenya is the most permissive country, with the accepted concentration of 50 mg/l, up to five times higher than the TN allowed concentration in Uganda, Tanzania or USA.

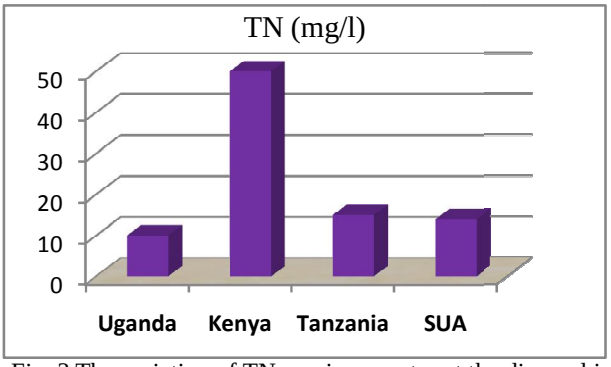

Fig. 3 The variation of TN maximum rates at the disposal in water bodies

Analyzing the TP charging limits of wastewaters on the discharge into the natural receivers, Fig. 4, high values are identified, of 10 mg/l in Uganda, 6 mg/l in Kenya and Tanzania, while in USA, the maximum allowed value is of 2 mg/l.

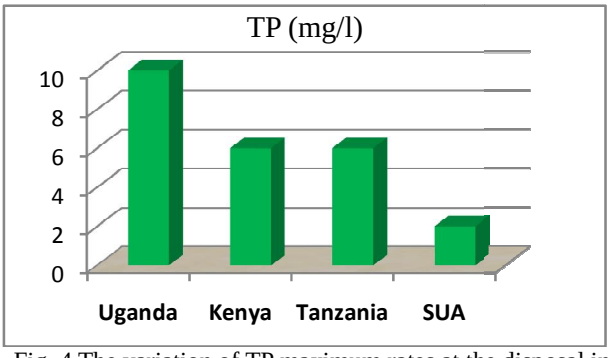

Fig. 4 The variation of TP maximum rates at the disposal in water bodies

The graphic representation of TSS, Fig. 5, shows that Uganda, Kenya and USA have the same allowed limit values of 100 mg/l, while paradoxically Kenya has the smallest allowed value, of 50 mg/l.

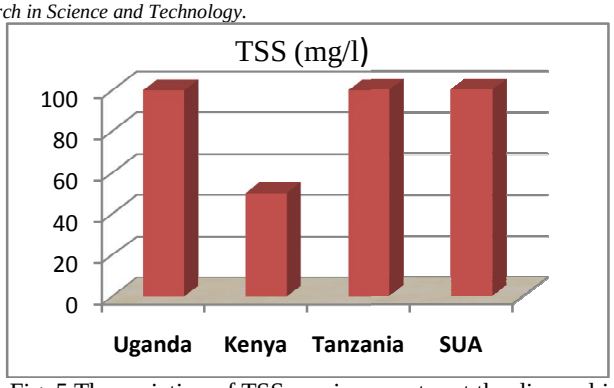

Fig. 5 The variation of TSS maximum rates at the disposal in water bodies

IV. CONCLUSIONS AND PERSONAL CONSIDERATIONS

Considering the existing discrepancies between the minimum allowed values of pollutant discharge for the two continents, it is necessary to implement a global legislative framework concerning the minimum mandatory conditions to discharge ground waters into the natural environment, to achieve a balance in the efforts that all the countries must make with the joint goal of protecting the environment.

The discharge of insufficiently treated domestic wastewaters into the water courses affects the quality of ground waters of the other states and continents. The comparison of the discharge standards into water bodies, issued for the same pollution parameters that are representative on the territory of the two continents, as well as another study comparing the discharge standards into water courses for the European and Asian continents, reveal the absence of a global legislative framework setting maximum allowed values, easy to implement, for all the countries. Depending on the economic capacity and quality standards of water sources demanded for each continent, more stringent continental legislative frameworks than the global ones may be set.

The efforts to protect the environment must be intensified, especially on the African continent, since many countries do not have national standards concerning the treatment of domestic wastewaters. Most countries included in the study benefit from treatment standards drafted and demanded by the World Health Organization. The implementation of a global legislative framework would increase the efforts to protect the environment in Africa, and would be a legal financing basis for the building of treatment plants.

The manner in which USA, which may be assimilated to a continent (having approximately the same area as Europe), has managed to draft easy-to-observe and flexible, but also mandatory legislative frameworks, is an example to follow. Having set the federal legislative framework that must be observed to protect the environment, each State has the freedom to set more restrictive norms, depending on the pursued quality of water resources, on the financial power or on the elimination of more important pollutants, according to them. Such an example is to establish the maximum allowed value of TSS in effluent for each State. The federal law demands the maximum value of 100 mg/l, but most States have limited this value to 90 mg/l, some opting for values of

up to 40 mg/l (Table 6).

For the African continent, it is necessary to implement a continental legislative framework of water protection setting maximum allowed limits of pollutant discharging, easy to observe by all African States. Depending on the economic capacity of each State, it may establish stricter treatment standards.

Water is a common asset of the planet, and each continent has the obligation to protect water against the effects of pollution for the wellbeing of all mankind. The importance of water for the environment must become a global component, and the implementation of a global legislative framework of protection of water resources is imperative. At the same time, the economic efforts submitted by each continent to protect the environment must be balanced, and fairness is required in terms of the financial resources that are available and spent on each continent.

ACKNOWLEDGEMENT

This paper has been completed due to the support of the Doctoral School within the Technical University of Cluj-Napoca.

REFERENCES

[1] Mureşan, M.V., Pic□, E.P., Comparative Analysis on the Legislative Requirements of Wastewater Disposal in Water Bodies for Asia and Europe, Global Research Analysis, Vol. 2, No. 9,pp. 52 -54,ISSN 2277 – 8160, 2013.

[2] Jacobsen, M., Webster, M., Vairavamoorthy, K., The future of Water in African Cities Why Waste Water?, The World Bank Washington, D.C., 2013.

[3] African Minister's Council on Water, Freshwater under Threat Africa, United Nations Environment Programme, South Africa, 2008.

[4] The East African Community – Lake Victoria Basin Commission, EAC Regional Standards for Industrial and Municipal Effluent Discharges into Sewerage and River Systems. Ministry of Environment and Mineral Resources, 2011.

[5] The National Environment Act, Standards for Discharge of Effluent into Water or on Land Regulations, Uganda, 1999.

[6] Tanzania Bureau of Standards, National Environmental Standards Compendium, Tanzania, 2005.

[7] U.S. Environmental Protection Agency, NPDES Permit Writer's Manual, Office of Wastewater Management, Water Permits Division State and Regional Branch, Washington, D.C., 2010.

[8] United States Environmental Protection Agency, New NPDES Non-Municipal Permit Rating System, Washington, D.C., 1990.

[9] Gale, L., Roberts, P.E., Effluent Limits/Technology-Based Effluent Limits/Domestic Discharges/Secondary Treatment, 2005. Retrieved from: http://www.dnr.mo.gov/env/wpp/permits/manual/5_3_2_1.pdf .

[10] Mureşan, M.V., Optimal Treatment Technology for Rural Wastewater: Constructed Wetlands, Scientific Bulletin of North University of Baia Mare, Vol. 26, No. 2, pp. 101 – 109, ISSN 1582-0548, 2012.

[11] U.S. Environmental Protection Agency, National Pollutant Discharge Elimination System (NPDES) Multi-Sector general Permit for Stormwater Discharges Associated with Industrial Activity, 2013. Retrieved from: http://www.epa.gov/npdes/pubs/msgp2013_proposedfs.pdf