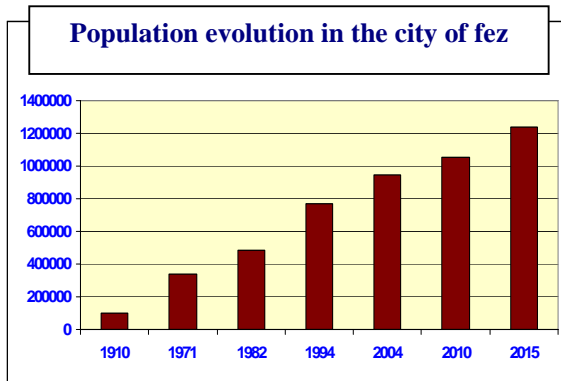


WASTEWATER IN THE CITY OF FEZ

(Prepared by Sebou basin Agency and Autonomous electricity and water distribution company)

Introduction

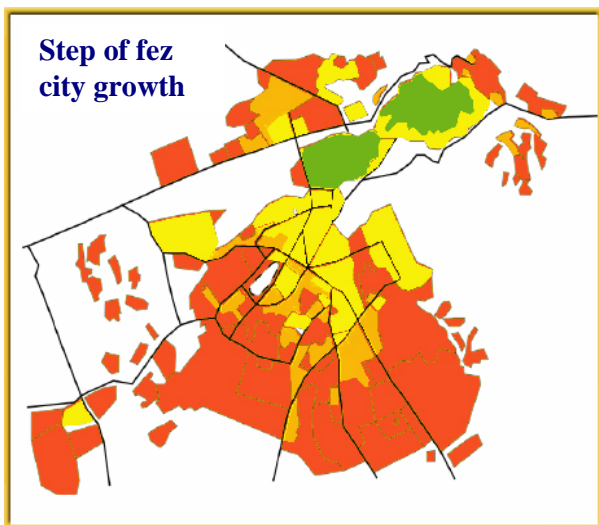
The city of Fez, classified as universal heritage by the UNESCO, was built at the end of the 8th century on right side of the Fez river. Nowadays, Fez is the administrative capital of the Fez-boulemane region. The geographical situation of this city along with its economic potentials, its historical and cultural background in addition to the sightseeing attractions has conferred to this city a dominating role of national metropolis and a regional economic development pole.



The city is characterized by a growing population. The population has passed from 100.000 in the beginning of the 20th century around 1.000.000 one hundred year after.

During the last two decades (1970-1980 and 1980-1990), the population growing rate was due mainly to a migration flux from the rural areas and the nearby cities.

This accelerated evolution of the urban population is characterized by an unequal distribution through the different city districts. In fact, the population of the Fez-Medina district is more than 260.000 (28% of the total population of the city) according the 2004 national census. This situation has led to higher population density in some neighbourhoods in the medina (100.000 people/sq.km).



The agglomeration of fez is composed by three geographical urban units :

- The Medina, the ancient highly dense part of the city which has undergone several extensions toward the east.
- The modern part of the city less dense represent about 60% of the city constructed space.
- The news extensions in the southern and western part of the city

The city of Fez is well known by its hydraulic potential. Fez is crossed by several watercourses like Ain chkef, Ain Smen, Miyet, Mahrez and Boufekrane. This network of theses watercourses forms the Fez river which is an affluent of the Sebou river one of the

most important river in Morocco. The city of Fez lies on two aquifers surface aquifer and a deep aquifer which can reach up to 1500 m.

Drinking water sector

The city of Fez is supplied with drinking waters from:

- deep wells used by RADEEF (Autonomous electricity and water distribution company) which provides 28%
- deep wells and treated surface waters from ONEP (National Drinking Water Office) which provides 72%

The total discharge of water resources managed by these two departments is around 3942 l/s which can meet the water need up to the year 2015. The city drinking water storage infrastructure is composed of 17 reservoirs which guarantee thirteen hours of distribution autonomy.

	Discharge in l/s		Total in l/s
	Groundwater	Surface water	
RADEEF	617	-	617
ONEP	1725	1600	3325
Total	2342	1600	3942

Drinking water distribution is managed by RADEEF only. The rate of connections has varied from 74% in 1994 to 98% in 2005.

During the 2005, RADEEF has distributed 69 million of cubic meters to meet the population needs estimated at 2148 l/s for a total number of customers of 213.000. The specific discharge par person is 100 l/day.

Sewarage sector

The Fez sewage network has a length of 1700 km. The existing sewage system is mostly unitary except in the extended zones where the separate system is adopted.

Since 1996, RADEEF is in charge of sewerage in the city of Fez. Several actions have been accomplished to restructure the main network. The most important works were done between 1999 and 2005 and were financed by the World Bank for a global cost of 40 millions of US dollars. These works have allowed:

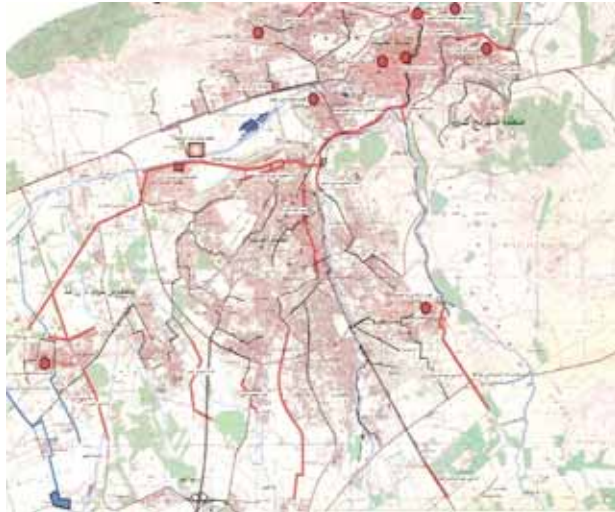
- the realization of main urban wastewater framework
- the extension to the newly opened zones for urbanization
- the elimination of wastewaters discharge to rivers

These works have a positive impact on the environment in the city of Fez, on the enhancement of the infrastructure of the old constructions in the medina and on the health conditions of the population. The rate of connection to the sewage network has passed from

90% in 2000 to 95% in 2005. The main objective in this purpose is to reach 100% by the year 2010.

On another hand, stormwaters are evacuated by the hydrographic network formed by several small rivers crossing the city from south and south-west to north-east.

WASTEWATER MAIN NETWORK



STORMWATER NETWORK



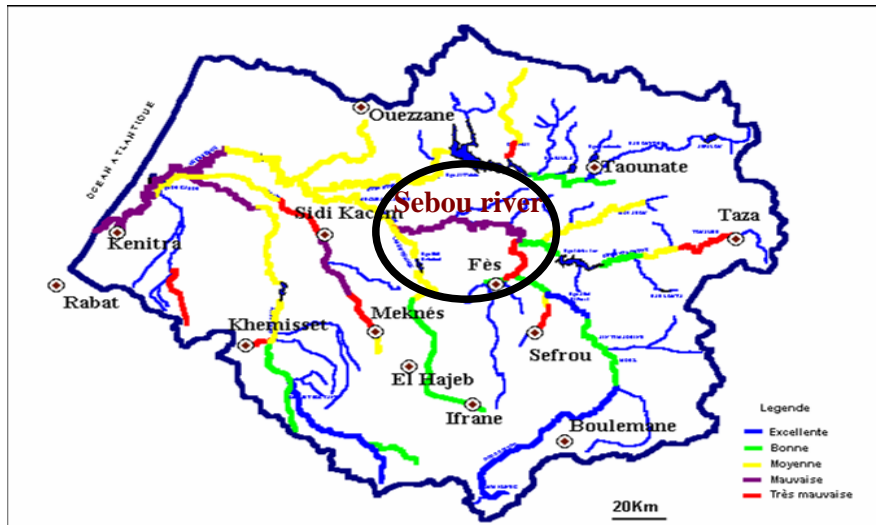
The total volume of the pollution generated by the city is about 37 millions of cubic meters coming mainly from the domestic pollution of an equivalent population of 1.000.000 inhabitant and from wastewater discharge from different industries.

The next table gives the key figures on the pollution:

	2004	2015
Average wastewater discharge (m³/day)	100.686	128.734
Domestic pollution (T BOD₅/day)	31	41
Industrial pollution (T BOD₅/day)	33	32
Total pollution (T BOD₅/day)	64	73
Equivalent inhabitant	1.045.000	1.215.000

The domestic pollution represents 49% of the total organic pollution and will reach around 56% by 2015 representing an increasing rate of 30% in a period of 10 years.

Nowadays, the total amount of pollution generated by the city is evacuated in the Sebou river without any treatment. This pollution contributes to 40% of the pollution generated in the Sebou basin. The medium part of this river presents a poor water quality which affect the different water uses downstream the river.



The different sources of pollution, their importance and the types of pollutants (organic, chemical, toxic,...) have caused a negative impacts which have affected several sectors such as water resources management, drinking water production, agriculture, human health and the ecological equilibrium of the environment.

Wastewater treatment projects

Urban wastewater treatment plant

The study of the wastewater master plan of Fez has started in the beginning of the 90's. The technical solution adopted for the effluent treatment consists of a natural pound system on a surface of 150 hectares. A recent study (2005) has abandoned this solution for activated sludge solution. Two sites were selected:

- Site A in the western part of the city for the treatment of 25% of the pollution and to support natural flow in the Fez within the city
- Site B to the north in the city will allow the treatment of the remaining 75%

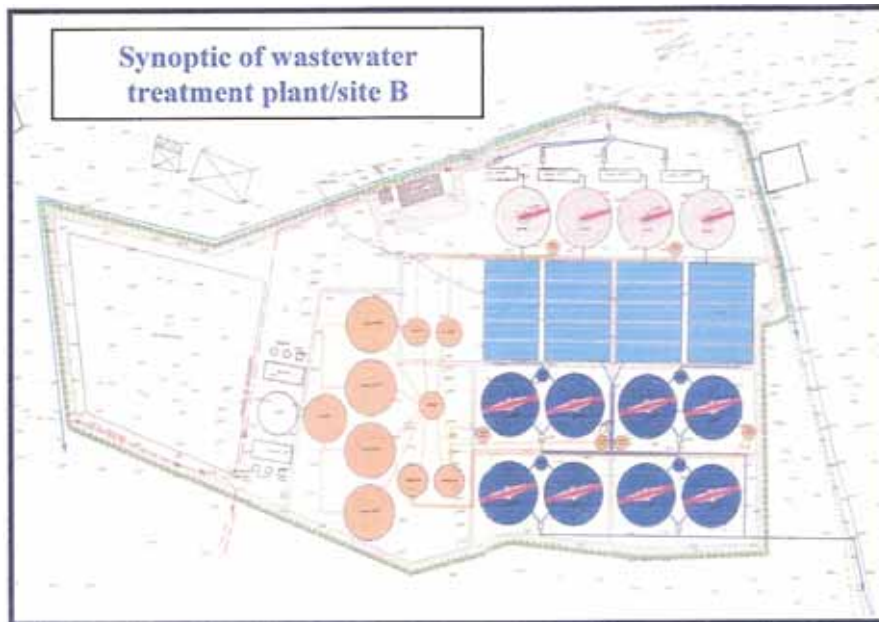


The construction works of the first phase will start at the end of 2006 for two years. These works concern the site B using the process of activated sludge. The objective is to fulfil the following quality requirements:

- water potabilization at the ONEP plants located 80 km downstream (class 1B)
- immediate restrictive irrigation downstream the location of the discharge (class 3)

This plant will include four identical treatment components composed as follow:

- primary decantation
- aeration pound
- secondary decantation
- Sludge treatment plant



It should be noted that this plant will include also a unit for the biogas valorisation (electricity production). This project will generate up to 22000 m³/day of biogas in the first phase and 37000 m³/day in the second phase. This energy production will meet the plant needs up to 46%.

The global cost of the sewage treatment in Fez is 100 millions of USD. The first phase represents 70% of this cost. The project financing will guaranteed by The European Bank of Investment (EBI) and French Development Agency (FDA) through loans with lower rates in addition to Government grant and the Sebou Hydraulic basin Agency grant, and RADEEF self-financing:

- FDA loan	:	20 million USD
- EBI loan	:	20 million USD
- Government grant	:	3 million USD
- the Sebou Basin Agency grant	:	3 million USD
- RADEEF self-financing	:	20 million USD

Industrial wastewater treatment

In the framework of the Fez wastewater treatment project, industrial wastewater treatment at the level of the different industrial plants connected to the network constitutes compulsory and preliminary component. For this purpose a specific study was done to identify the industrial plants which pollute the most and which necessitate a pre-treatment before

connecting them to the city wastewater network. The objectives of the pre-treatment are to protect the sewage network and the efficiency and the operation of the future urban wastewater treatment plant.

Industrial activity	Number of plants	Pollution (equivalent inhabitant)
Olive oil	47	500.000
Surface metal treatment	34	350 kg/day of chrome
Leather industry	36	50 kg/day of heavy metals (Ni,Ag,Cr,CN,...)
Bakery soda industry	1 (SODERS)	123.000
Beer Industry	1 (BRANOMA)	20.000
Soft drinks industry	1 (COCACOLA)	6.136
Textile	1 (MULTISH)	4.516
	1 (COTEF)	2.100
TOTAL		656.000 equivalent inhabitant 400 kg/day of heavy metals

The total cost of the industrial wastewater component is 5 million USD. The plants will start working during 2007. Its realization will be under a partnership framework between the Industrials, the Sebou Hydraulic basin Agency, and the FODEP (Industrial wastewater treatment fund managed by the Moroccan Environment department with the assistance of the German Government) and RADDEF. The key figures about the global cost are:

- RADEEF : will be in charge of the different studies
- Sebou basin Agency : donation of 20% of the investment cost
- FODEP : donation of 40%
- Industrials : 40% (in which 20% will be a loan from FODEP)

Currently, the partnership conventions are in the process of signature by the different partners. This money collection initiative is the results of the efforts made by each department to make this tremendous wastewater treatment project a priority at the regional level and at the national as well.

Water tariff

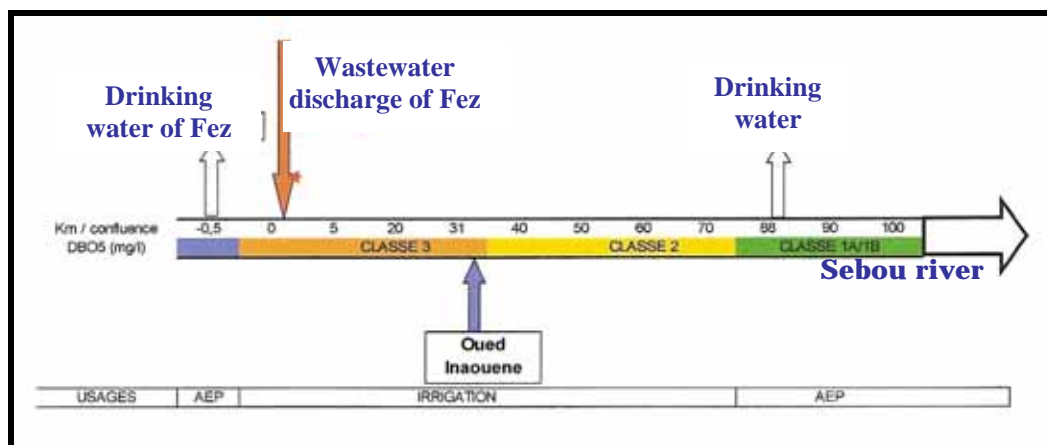
Current water tariff varies from 0.2 to 0.9 USD/m³, according to the social category. It is expected that the sewage tax will increase in the future from 0.15 to 0.3 USD/m³ in three steps between 2006 and 2008 in order to reach financial equilibrium. This increase will depend on the social acceptability and the capacity of the population to support it. In fact, the Governments, Sebou basin agency, FODEP grants, in addition to the FDA and EBI loans have reduced the costs to be supported by the population.

Also, the treatment level adopted (secondary level) associated to a restrictive irrigation downstream presents more advantages than reaching for a tertiary level which would allow a

non restrictive irrigation. In the tertiary level, the sewage tax will be about two times more compared to the secondary level.

CONCLUSION

When the future treatment plants will be in service, effluent discharge will be reduced to 85%. The simulated evolution of the sewage quality in given below :



Oued Sebou water quality after treating pollutants from the city

The realization of the sewage project of the city of Fez will allow 1) a consequent improvement of the population life quality at the regional level, 2) a positive impact on the population health, 3) will lead to economic development of agriculture, fishing and tourism and, 4) to a aquatic ecosystem rehabilitation not only in the Fez region but also at the basin level. The predicted positive impacts of the sewage treatment of the city are:

- **a rational water resources management** allowing :
 - to meet the population needs along the Sebou river,
 - to guarantee a continuous drinking water production from the Sebou river drinking water plants located downstream the city,
 - To avoid to release water from the upstream dams to reduce pollution.
- **An improvement of the sanitary conditions** with risk minimization due to the direct contact of the population with sewage or to the use of the polluted waters in irrigation. The sanitary impact dues to the lack of the city sewage treatment are evaluated at **one million USD**
- **Social and economic development** en particular of the agriculture sector. The treated waters will allow the irrigation of 1500 hectares in a restrictive irrigation downstream the city. In addition, the entire Sebou valley will benefit from this to develop the agriculture activities. If no treatment is made, the loss in term of agriculture production and the deterioration of soil quality can be estimated to **3 million of USD per year.**