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# IMPACT OF SUSPENDED MATTER ON DRINKING WATER PRODUCTION: THE FES, MOROCCO, CASE

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ABSTRACT

The levels of suspended matter in the Sebou river and their impact on the water supply system for the city of Fes, Morocco, are analyzed.

KEYWORDS

River water, suspended solids, water supply.

## INTRODUCTION

The natural phenomena of soil erosion and carrying of solid materials by water cause many problems such as the settling of these materials in the water reservoirs and lakes and problems for the operation of hydraulic equipment, especially drinking water treatment plants.

The contribution of the human and natural factors to the degradation of water quality depends on the properties and characteristics of the water catchment area. The present document analyzes the impact of suspended matter on the drinking water supply from the Sebou river for the city of Fes.

## WATER CATCHMENT AREA CLIMATE OF THE SEBOU RIVER

The Sebou river catchment area spreads over 40 000 $km^2$ in the northwest of Morocco. The basin is under humid and cold climate characterized by a dry season extending from June to October and a rainy season extending from November to May.

The mean annual rainfall is 600 to 900 mm in the south western part and up to 1100 mm in the north eastern part.

## EROSION IMPACT ON THE WATER TREATMENT PLANT OPERATION

Before 1987, the city of Fes was supplied for its drinking water by underground sources of the Sais profound groundwater, which witnessed significant drops in output during the years of the drought. In the medium and long terms the needs for water could be covered only by recourse to surface water. Thus the decision to treat the Sebou river water was taken and the operation of water treatment plant started in 1987.



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Following each flood the Sebou river carries considerable amounts of suspended matter. Turbid water is observed during the year with a suspended matter load (SML) over 2g/l and sometimes up to 50g/l. The suspended matter load maxima values are observed during September.

The treatment of the Sebou water cannot be accomplished only by the classical surface water treatment train, it requires a unit process to remove suspended matter during the period of floods in winter and during storm weather.

The Fes water treatment plant has a standard treatment process (prechlorination, flocculation, coagulation, decantation, filtration and disinfection). This train of systems is preceded by a pretreatment step (grit removal and presettling) for sand and other suspended matter extraction with the possibility of reagent use in order to bring down the suspended matter load from 50g/l to 2g/l, which is the expected load when water is treated in a classical treatment train plant.

## ANALYSIS OF THE TREATMENT SHUTDOWN OCCURRENCES

Three thresholds of suspended matter concentration will be taken into consideration in this analysis:
- a load lower than 2g/l for which standard treatment at the processing plant is sufficient,
- a load between 2g/l and 50g/l for which a pretreatment step is mandatory in order to bring the load down to 2g/l. With a load higher than 20g/l the station works at only half its capacity,
- beyond 50 g/l the pretreatment step is not sufficient and interruption of drinking water production is imposed. In this case only the increase in the storage capacity by constructing other treated water reservoirs can guarantee the continuity of drinking water supply during the period of the station work interruptions.

In 1987 the suspended matter concentration was higher than 2g/l for 1496 hours (62 days) which is 17% of the observation time of this study (Fig. 1). This has caused 16 interruptions of the water treatment plant lasting 1359 hours (about 57 days) (Fig. 2). The longest continuous interruption time was 72 hours. The water load in suspended matter was larger than 50g/l during 171.5 hours (7.15 days), about 2% of the observation period of the plant operation. The water load was larger than 20g/l for 424.5 hours which is 4.8% of the observation period. In 1987 the realization of a pretreatment plant could have contributed to decrease the functioning interruption time of the plant from 15.5% to 2%.

In 1988 the suspended matter load was lower than that of 1987. The plant stopped functioning for 348 hours, corresponding to 4% of the observation period (Fig. 2). The water load was larger than 2g/l for 542 hours, about 6.2% of the observation period (Fig. 1). In 1988 the realization of a pretreatment plant could have avoided the functioning interruption of the water treatment plant.

The construction in 1989 of a pretreatment plant reduced the number of water treatment plant functioning interruptions. The plant interrupted its work for 326 hours (Fig. 2), i.e. about 14 days as opposed to 57 in 1987. Thus, the work interruption of the station was reduced by 75%. The suspended matter concentration was larger than 2g/l for 1685 hours in 1989 versus 1496 hours in 1987. This shows an increase of 12.6%. The 50g/l threshold was exceeded for 231 hours (7 days) which is 2.6% of the observation period (Fig. 1). The longest interruption of the plant was 65 hours (2.7 days) which could have been 176 hours (7.3 days) without the pretreatment steps.

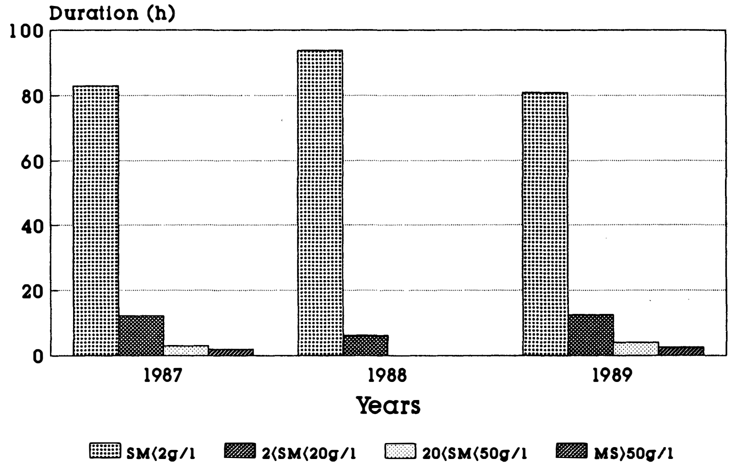


Fig.1. Overstepping duration of thresholds of suspended matter concentration in percent

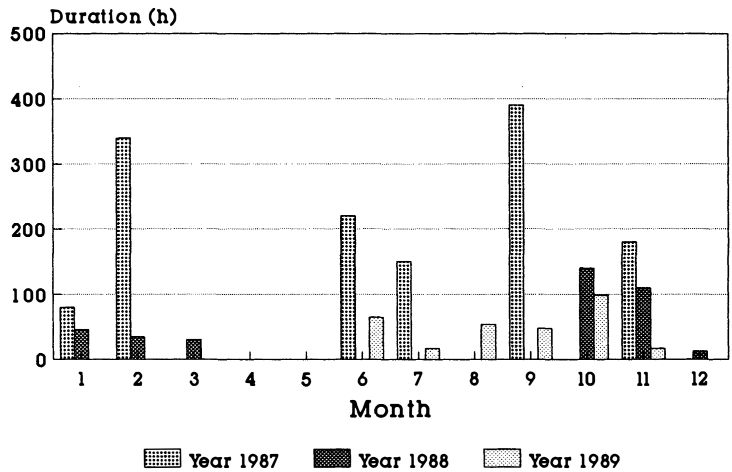


Fig.2. Duration of plant shutdown occurrences

## STATISTICAL APPROACH

A statistical approach based on the analysis of the follow-up results of the suspended matter in the water in 1987 has permitted us to predict the most probable durations of station shutdown occurrences and production flowrate reduction depending on the three thresholds: 2g/l, 20g/l, and 50g/l.

The results obtained using this approach predict in the worst case that the longest interruption time of the station would be 98 hours. This corresponds to the time during which the 50g/l threshold is exceeded. The decrease in production flowrate could happen for 131 hours at most, which corresponds to a threshold of 20g/l. These results were supported by the observations done in 1989. During the running of the pretreatment plant, the time when the threshold of 50g/l was exceeded was 42 hours. If we take into consideration the possible overlap of two successive excess occurrences this would have a maximum value of 66 hours.

The use of the same approach during three years of observation, 1987 to 1989, showed small differences in the time where the thresholds were exceeded:

- 369 hours for the threshold of 2g/l
- 111 hours for the threshold of 20g/l
- 72 hours for the threshold of 50 g/l

This suggests that the station operation should not be interrupted more than 72 hours and the running of the installation at half-flow should be observed continuously at most for 111 hours (Fig.3).

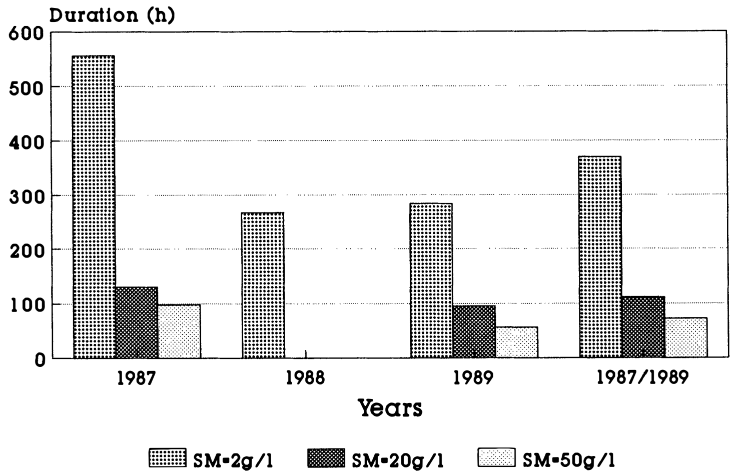


Fig.3. Maximal duration of overstepping

## CONCLUSION

The studies on the surface waters conducted by the ONEP showed that these waters are exposed to pollution brought about by rejected liquid and solid matter. This led the ONEP to carry out work in order to respond to the specificity of the problems posed. The aim is to provide a continuous supplying of drinking water.

The investment and operation costs increased rapidly with the complexity of the process of treatment. Thus, the price of a cubic metre of drinking water is higher. This is the case of the city of Fes where it was necessary to undertake a pretreatment and to construct extra storage reservoirs in order to have a continuous supply for the city during the period of quality degradation of the Sebou water.

The water pretreatment represents about 40% of the total investment cost of the Sebou water treatment. The second component in the cost of production is the station operation. This cost depends on the type and amount of reagents used, the amount of pumping energy and the pretreatment system and the maintenance of the equipment.