A6

ASSESSMENT OF INDUSTRIAL WATER DEMAND: SOME REGIONAL SURVEYS EXPERIENCES

by

Fausto Maria Spaziani
Research Officer
Water Research Institute
National Research Council
Rome, Italy

SYNOPSIS

The assessment of water requirements for industry acquires particular importance for a rational planning of water resources aimed at an efficient utilization of available sources and in order to guarantee requirements necessary for future industrial expansion.

With the aim of securing data useful for the definition of a sufficiently reliable picture of the Italian water supply situation for industrial usages, a number of nation-wide and single hydrographic basins surveys, structured by samples and in successive steps, were carried out on a meaningful number of production units of water-using industrial sectors.

The main features of water utilization in industry were examined and a survey methodology suitable to be used in later studies was defined.

This paper illustrates some specific parameters for water utilization, such as unit water requirements and recycling.

These parameters are of considerable relevance for the proper determination of how to best use water resources.

RESUME'

L'évaluation des besoins en eau pour l'industrie revêt un intérêt particulier aux fins de la planification des ressources en eau adressée à une efficace exploitation des sources disponibles et à la garantie de la demande d'eau pour les nouvelles réalisations industrielles.

Dans le but d'obtenir des informations utiles pour une évaluation suffisamment valable de la situation italienne dans le domaine de l'approvisionnement en eau pour l'utilisation industrielle, des enquêtes sur échantillon ont été effectuées, concernant un nombre d'unités productives représentatif des secteurs industriels les plus intéressés à l'utilisation de l'eau.

On a examiné les principaux aspects de l'emploi de l'eau dans l'industrie et on a mis au point une méthodologie de relèvement qui est susceptible d'être utilisée dans des enquêtes successives.

On presente ici quelques paramètres specifiques de l'utilisation de l'eau, tels que les besoins unitaires et les recyclages. Ces paramètres revêtent un intérêt remarquable aux fins de la définition des choix rationnels sur l'utilisation des ressources en eau.

RESUMEN

La valoración de las necesidades de agua para la industria asume particular importancia a fines de una racional planificación de los recursos hídricos, dirigida a una eficiente utilización de las fuentes disponibles y a la garantía de los abastecimientos necesarios para las futuras realizaciones industriales. Con el propósito de obtener los elementos esenciales para definir una imagen atendible de la situación italiana de los abastecimientos hídricos para utilización industrial, se han realizado una serie de investigaciones efectuando muestras en sucesivas faces a nivel nacional y de distintos embalses hidrográficos, sobre un numero representativo de unidades productivas de los sectores industriales que utilizan agua. Han sido examinados los principales aspectos para el empleo del agua en la industria y se ha elaborado una metodología de recogida de datos susceptible a ser utilizada en sucesivas investigaciones.

Se presentan aqui algunos parámetros específicos de empleo del agua, como las necesidades unitarias y la reutilización. Dichos parámetros tienen un considerable interés a fin de una correcta eleccíon de utilización de los recursos hídricos.

1. INTRODUCTION

The problem of water supply for industrial purposes is becoming increasingly important in connection with water resources planning. This issue has been complicated by the progressive deterioration, caused by pollution, of available resources. It is well known that whenever industry-used waters do not undergo suitable treatments prior to restitution, not only they cannot be used again but sometimes they also jeopardize the quality of other waters.

Considering the additional and foreseeable increases of water requirements for industrial purposes, we may either create new natural and artificial supplies or rationalize usage by adopting technological devices which limit water demand.

The formulation and utilization of efficient criteria and methods for a rational management of industrially used water resources are therefore mandatory.

For this purpose it is of basic importance to acquire useful data for the assessment of water requirements by the various industrial sectors. The identification of said requirements and of water availability in the different areas, will enable us to rationally decide the type, the density and the distribution of industrial installations in a certain area.

Water requirements for industry vary according to many quantitative and qualitative factors: potentiality, type of the installations, structure of the process, entity of the recycles, quality of the supply water and acceptable quality for the discharge, personnel training, and other factors.

Up to a few years ago, available data in Italy on industrial water requirements were badly incomplete and fragmentary and did not consent comparative studies of the situation. It was, therefore, highly necessary to fill this information gap in order to prepare organic plans for the exploitation of water resources capable both to use efficiently available sources and to guarantee requirements for future industrial settlements.

These data were particularly essential in the most arid areas, such as the South of Italy which in recent years has witnessed a remarkable industrial expansion, characterized by installations which not always were located as a result of a careful check of the availability on the spot of adequate fresh water resources.

It is because of the above considerations that the Water Research Institute of the National Research Council carried out a number of nation-wide and individual basin surveys on the issue of water supply to industry. These studies, started in 1970 and continued in successive phases up to 1978, were carried out by sampling on a representative number of production units belonging to the various water-using industrial sectors. Data were collected in cooperation with the major Government and private Agencies, interested in the problem of water supply for industry.

This short paper presents some aggregated and overall results of the above studies with particular care for specific parameters

of water usage, such as unitary requirements and recycling, felt to be of particular relevance for comparison purposes and in view of their possible transferability. Such parameters make up the elements necessary to determine the initiatives which enable a rationalization of decisions on how to use water resources as well as the programming of related industrial growth.

2. RESULTS OF THE SURVEYS

Data collected during the surveys implemented at different territorial levels, have enabled us to secure a sufficiently reliable indication of the Italian situation for what concerns water supply for industrial purposes.

We have, furthermore, perfected a methodology of data collection which may be used in successive surveys for the various industrial sectors as well as for individual territorial units, also of a "district" dimension.

The surveys have been carried out both by sending questionnaires and also by direct visits to the productive units which were chosen in view of their typology, dimension and territorial location.

The appropriately processed responses to the questionnaires have enabled us to determine:

- water demand in its annual cumulative dimension and in its maximum (instantaneous) value
- water requirements per unit of production and per employee
- recycling degree, and therefore the specific requirements of total water used in the production process
- real consumption, considering losses, evaporation, utilization in the product
- percentage of brackish and sea water utilization
- water supply sources
- final receiving body of discharge waters
- probably evolution in time of water demand.

As to the determination of the specific parameters of water usage which, as above indicated, may be of interest for this report, data processing caused some difficulties due by and large to the heterogeneity of the various industrial productions and to occasionally inexact information with regard to water destination and utilization within the installation.

In order to eliminate or to reduce as much as possible errors in the assessment of the water balance, the results of the survey have been systematically discussed with the cooperating Agencies and in particular with the Industrial Associations in order to check the compliance of said estimates with the quantity produced and with the number of employees in the installation.

2.1 Unitary water requirements.

In order to determine the specific requirements, it was deemed necessary to divide the plants fed exclusively with fresh water from those fed with both fresh and sea water. Water utilization criteria,

in fact, vary substantially for installations using sea water in addition to fresh water. It is obvious that estimating water usage for industrial purposes, the use of sea water, whenever processes permit it, may considerably reduce the requirement of fresh water and this fact may influence the selection of future industrial installations.

Table 1 illustrates the average unitary water requirements, expressed in terms of produced quantities for the main industrial sectors. The figures indicated are mean values of the situations found to be most frequent and do not consider evaluations on the optimal utilization of the water and on technologies applied or applicable in the production process. They are, therefore, values which may be economically achieved in ordinary water utilization conditions.

A perusal of the table evidences that, wherever possible, the utilization of sea water noticeably reduces fresh water requirements.

It is therefore opportune to repeat that, particularly in arid areas in the proximity of the sea, it is necessary to select carefully the location of future industrial settlements. By rationalising the use of different types of water (brackish and sea water) and using systems capable in any case of reducing water utilization (air cooling, for example), the demand of fresh water may be considerably limited. For what concerns the utilization of the unitary water requirements, expressed in terms of produced quantities for the purpose of assessing industrial water demand, we must point out that in Italy statistical surveys on industrial productions are carried out each year, but said surveys do not embrace the full range of production activities. More specifically, in the case of sectors characterized by a high fragmentation and dissemination of the production plants, such as the food, mechanical and textile industries, official statistical findings cover only the most economically relevant productions.

For these sectors, however, it is possible to have data on the number of personnel involved. These data, in fact, constitute the object of a General National Census periodically implemented, covering all production sectors at various and detailed level of disaggregation of the industrial categories and of the pertinent territorial units.

In order to have a complete assessment of industrial water demand at the national, regional and district level, it is therefore necessary to use unitary "per employee" values of water requirements. Particular attention was therefore addressed to the determination of those values which data collected during the various surveys made available with a sufficient degree of approximation for a large number of production sectors.

By way of example, Table 2 illustrates the specific requirements of fresh water expressed in terms of employee for the main production sectors according to the aggregated classification adopted by the above mentioned General Census.

2.2 Water recycle

For the purpose of obtaining information on water utilization modalities within industrial units, data were collected on the total quantity of water used in the production process, identifying the recycled volume of the water.

Table 3 evinces some recycling coefficients related to fresh water for plants exclusively fed with fresh water.

For the various production sectors such coefficients show the ratio of the total quantity of water used to the quantity of the supply water. It is obvious that by using said coefficients and the previously mentioned unitary water requirement, it is possible to determine the average requirement of water used in each production sector.

3. CONCLUSIONS

Data acquired during the survey on water supplies for the Italian industry, herein briefly illustrated, have permitted a sufficiently detailed description of the situation of water utilization in several production sectors. We may consider the results of the processing of the huge number of data collected as sufficiently representative and reliable and same may be properly used for a preliminary assessment of water requirements for industrial utilization.

During the various steps of the survey it was also possible to identify the difficulties inherent to the definition of data collecting methodologies in this field and it was likewise possible to determine the strategies necessary for additional and more thorough surveys. Such surveys are of particular importance for a rational planning of water resources only if they can be regularly and periodically updated, capturing the modalities of the evolution of the industrial structure and of production technologies.

REFERENCES

(1) MERLI, C., PASSINO, R., SPAZIANI, F.M.: "Water Use in Industry", Quad. Ist. Ric. Acque, 15, (Roma, 1973) (in Italian).

(2) FARNESI, B., PUDDU, A., SPAZIANI, F.M.: "Industrial Equivalent Inhabitants", Quad. Ist. Ric. Acque, 33, (Roma, 1976) (in Italian).

TABLE 1

Unitary water requirements (m^3/t) for plants fed exclusively with fresh water (A) and for plants fed with both fresh and sea water (B)

Industrial Sector	A	B	
	Fresh Water (m^3/t)	Fresh Water (m^3/t)	Sea Water (m^3/t)
Chemicals	84.3	14.1	372
Primary Iron and Steel	10.9	0.5	18
Steel Rolling and Finishing	41.3	4.1	33
Coke	3.3	2.2	15
Petroleum Refining	1.4	0.7	9
Paper	184.6		
Metal Products	21.7		
Glass	21.2		
Textile	272.6		
Non Ferrous Metals	60.5		
Rubber	148.3		
Canned Foods	10.5		
Frozen Foods	161.8		
Beer	23.8		
Beet Sugar	200.0		
Leather Tanning and Finishing	443.5		
Cement	0.5		
Ceramics	9.3		
Abrasive	25.0		

TABLE 2

Unitary water requirements (m^3/employee per day) for fresh water fed plants.

Industrial Sector	m^3/employee.d
Cereal and Bakery	9.6
Candy Products	1.4
Canned Foods	5.9
Dairies	3.1
Animal and Vegetal Fats	18.0
Beet Sugar	10.7
Winery and Distillery	9.7
Soft Drinks	2.9
Tobacco	1.0
Textile	4.1
Leather Tanning and Finishing	3.3
Wood Products	3.1
Primary Metal Industries	10.6
Metal Products	1.5
Transport Equipment	1.6
Stone, Clay and Glass	4.6
Chemicals	15.1
Rubber	4.7
Synthetic Fibers	13.5
Paper	44.2
Photographic Industry	0.5
Plastic Products	3.1

TABLE 3

Recycling coefficients (RC), expressed as ratio of the total water used to the supply water, in fresh water fed plants.

Industrial Sector	RC
Chemicals	1.9
Primary Iron and Steel	2.3
Steel Rolling and Finishing	1.7
Coke	3.2
Petroleum Refining	6.1
Paper	1.8
Metal Products	1.3
Glass	3.4
Textile	1.0
Non Ferrous Metals	1.3
Rubber	1.1
Canned Foods	1.2
Frozen Foods	1.1
Beer	1.1
Leather Tanning and Finishing	1.0
Cement	1.9
Ceramics	1.2
Abrasive	1.0