ULTRAVIOLET DISINFECTION IN A CABLE CONTACTER:
Influence of some physicochemical parameters
and UV light distribution.

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SUMMARY.

The initial concentration of micro-organisms, the presence of suspended
matters and of dissolved organic compounds in the test water has limited
influence on the sterilization efficiency in an "Amazone" cable contactor.
Actinometric runs show that the light energy emitted by the UV lamps is
poorly used in the contactor. This "fault" appears interesting for the
sterilization of highly absorbent liquids.

INTRODUCTION.

The technical feasability of the UV disinfection of microbiologically
contaminated liquids in an "AMAZONE" cable contactor has been previously demons-
trated (Delattre et al., 1988). This paper reports the study of some phy-
sicochemical parameters supposed to influence the efficiency of steriliza-
tion. It also reports attempts to optimize the pilot-scale apparatus geome-
try base on measurements of the UV energy distribution among the cables of
the installation.

The AMAZONE cable contactor performances are compared with those of
commercialized UV sterilization units.

MATERIALS AND METHODS.

The influence of the physicochemical parameters on the sterilization
efficiency is analysed, as previously (Delattre et al., 1988), in two steps:
firstly in a laboratory equipment fitted with a single cable and a single
UV lamp, and, secondly, in a pilot-scale apparatus containing many lamps
and more than 1000 cables.

Experimental parameters.

The influence of some experimental parameters was analysed in our
previous paper - distance between the lamp and the liquid film on the
cables, recirculation flow rate and micro-organism species. This paper
analyses the influence of factors in relation with the nature and the
quality of the treated liquid : quantity of suspended matters, concentra-
tion of dissolved organic species and initial number of micro-organisms.
Micro-organisms suspension and enumeration after irradiation.

In all runs, the same *Escherichia coli* wild strain, isolated by our laboratory from a polluted river, was used. Micro-organisms densities in test water ranged from 100 to 300 m.o./ml and complete sterilization of m.o. suspensions was performed (i.e. subcultures of 1 cm$^3$ of test water on Petri dishes showed no more growth).

Some runs corresponding to higher m.o. densities, about 200.10$^3$ m.o./ml, were performed with a view to compare sterilization kinetics in relation to the m.o. initial concentration.

Cultures of the same age were always used. Each sample taken during irradiation was duplicated to enhance precision.

Study of UV light distribution in the contactor by actinometry.

Due to its great complexity (non uniform distribution of the UV light, shadow effects, etc.), the AMAZONE contactor can hardly be theoretically modeled in all its details. Therefore, in order to estimate the UV energy distribution in the contactor, an experimental approach, based on the potassium ferrioxalate chemical actinometric test reported by Pitts and Calvert (1967), was used.

In this method, a suitable reactant A (potassium ferrioxalate) is chosen which absorbs light of the wavelength of interest (254 nm) and produces some product B (ferrous ions) with a known quantum yield $\Phi$. The energy $E$ absorbed by the system during the exposition time is given by:

$$E = \frac{n_B}{\Phi} N_A \frac{h c}{\lambda}$$

where $h c / \lambda$ = energy of a light quantum of wavelength $\lambda$.

The quantum yields of ferrous ion formation have been accurately determined by Hatchard and Parker (1956). Ferrous ion concentration is easily analysed by following the formation of an highly absorbing red complex with o-phenanthroline.

For actinometric tests, a batch of a potassium ferrioxalate solution was fed at the top of the cable nets and collected at the bottom. After homogenization of the batch, samples were taken for analysis.

RESULTS AND DISCUSSION.

INFLUENCE OF SOME PHYSICO-CHEMICAL PARAMETERS.

Influence of the micro-organisms initial concentration.

Runs performed on the one-cable equipment and on the pilot-scale apparatus show that large variations of the micro-organisms concentration have only a little effect on the sterilization performances (Figures 1, 2); the small differences observed may be attributed to a "micro-organism shield effet" at higher concentrations.