EFFLUENT LIMITS FOR DISCHARGES

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Summary

Emission Limit Values (ELVs) are used as environmental conditions when the competent authorities grant an operating permit to a facility. As the Emission Limit Values quantify the pollutants in terms of both quality and quantity, they can be measured. Thus, the ELVs are used to acknowledge the presence of a pollutant and to make it conform to the relevant legislation. The ELVs are defined by taking into consideration either the environmental prototypes or the Best Available Techniques (BAT). Usually the ELVs refer to the concentration of pollutants expressed in mass units per volume of emission or discharge as well as in mass units per one single product. The ELVs are one of the basic elements of legislation concerning the environment in many countries. They are also essential for constructing a permitting procedure and for monitoring the impacts of environmental pollution.

1. Emission or effluent standards

The term pollution refers to any change of a natural environmental system. Pollutants are defined as substances or energy that, as they are released into the environment, cause change in properties, and/or produce damages or malfunctions of the physical or biological systems of our planet.

Usually the release of pollutants in the working environment are distinguished from releases to the natural environment, and so they are examined separately. The releases go to their targets, for example to humans, through many paths. However, one path, called the critical path, is usually the main one. The critical path is essential to monitoring and treating pollutants. This does not mean that the other paths are of less importance. Consequently, all the impacts of a pollutant must be taken into consideration as a whole. For example, when the pollutant is lead and its target human health, the concentration of lead in blood is the result of many paths (i.e. the critical path (atmosphere) and secondary paths such as food).

The path followed by a pollutant or a group of pollutants may point to the possible levels at which limits aiming at pollution prevention and control may be set. The approach usually followed to fulfil pollution prevention and control entails measures aiming at:

- pollutant control at source;
- environmental media (pollutant transfer through the media of air, water, soil), and
- the target.

Measures aiming at prevention and control of pollution at source may be, for example, the appropriate design of the final product (e.g. catalytic converters in motor cars), the implementation of Best Available Techniques or Clean Technologies, etc. It may also be a modern environmental management system, such as ISO 14000, EMAS, Life Cycle Analysis. The setting of release (emissions, effluents, waste) limits is the measure usually taken to prevent pollutant emissions or discharges at the time the pollutant leaves its source. These limits are expressed in terms of legislation stipulating the amount of pollutant concentrations of flue gases, dispersion, fugitive emissions or discharges. Furthermore, these limits can be expressed in activity units such as capacity, production or energy units, or even more generally in terms of danger to the health of humans or the environment. The emission limit standards usually refer to Best Available Techniques aiming at an effective treatment of pollution by using some practical methods. However, during the treatment of releases, emission limits are set such that they do not cause damage, even when the release continues to disperse into the environment for a long period of time.

The standards, which refer to the media through which the release is dispersed, are the Environmental Quality Standards (Ambient Quality Standards). These are closely related to the emission limits.

Finally, when we refer to the target, which in most cases is the human being, we set standards for the disposal of a specific release or for other equivalent biological standards. Disposal limits are imposed for working areas, or other systems or substances that the systems are in contact with, such as quantity of drinkable water, concentration of chemicals such as pesticides, additives, etc).

The biological standards are related to the concentration of pollutants in human blood or tissue. It is pointed out that polluting releases can also be caused in cases of irregular production conditions, such as accidents in Seveso (Italy) and Bhopal (India), and wars. Restrictions or limits are set to eliminate possible impacts from situations like these.

Figure 1 shows the dispersion of pollutants in the environment and the possible points (e.g. end-of-pipe, certain stage of the manufacturing process) at which emission limits or equivalent measures could be imposed.

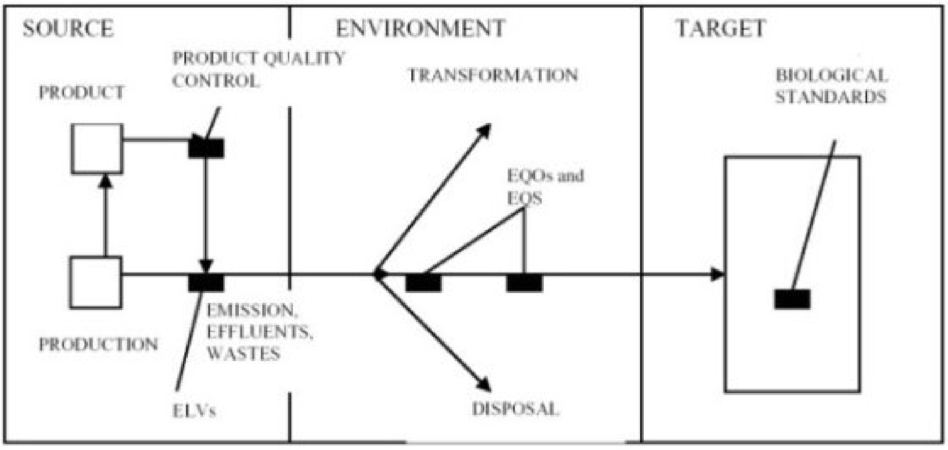

Figure 1. Pollutant route and positions of setting environmental standards

2. Environmental Quality Objectives (EQO) and Environmental Quality Standards (EQS)

A fruitful dialogue on pollution among all concerned parties of society should lead to an environmental quality system that reflects social relations and needs. The fulfilment of these requirements can be expressed as Environmental Quality Objectives (EQO) to be achieved within a certain period of time.

The EQOs should be in conformity with both national needs and international conventions. They should also be flexible enough so as to be implemented on subjects such as receiving water, the atmosphere and soil, or even the public. In the case of receiving water, an EQO could include fishery ecosystems, subjects of drinkable or irrigation water, etc. An EQO concerning the atmosphere could refer to the protection of public health and environment (e.g. avoiding acid rain, greenhouse effects and reduction of stratospheric ozone). In the case of soil, an EQO could include several issues of land use.

Environmental Quality Standards (EQS) must be developed for each substance with regard to a certain environmental quality objective, based on reliable scientific information. The EQS should be described in chemical or biological terms and they should express the maximum environmentally permitted concentration limits of certain substances (e.g. ozone) or group of substances (e.g. hydrocarbons). When an EQS refers to a specific EQO, it is obligatory that the standards for this EQO should not be exceeded.

The implementation of the set EQS does not refer to an ideal environmental condition. Instead, it expresses a level of social approval; in other words, a maximum tolerable environmental impact. An EQS can change over time. It is obvious that the implementation of more demanding standards will follow the implementation of more demanding EQOs. Moreover, the EQOs must be revised over time in line with scientific progress.

3. The setting of Emission or Effluent Limit Values (ELVs)

3.1 Stages of setting ELVs

The two stages usually followed in setting Emission Limit Values are:

- Evaluation and measurement of a pollutant, based on standard determination methods.
- Comparison between emission levels and the environmental quality standards for a specific area or receptor. An earlier evaluation of the environmental quality standards is essential.

Environmental quality standards can be set as legislative limits on pollutant emission. When the pollution level is over the set environmental quality standards, emission limit values must be set. These values are frequently used most appropriately to prevent and control specific pollutants.

Two approaches are followed for establishing ELVs: in the first, the setting of the ELVs is based on the technology used, as well as the technical and economic status or the operation. The second approach refers to ELVs based on environmental quality standards (EQS).

In the first approach, the technological possibilities as well as political, social and economic conditions dictate the decision to be made for setting limits. Although it normally results in an achievable implementation, there are certain cases in which the EQS cannot be followed. Of course, there is always the possibility of revising and resetting the ELVs. The determination of ELVs based on EQS is acceptable in theory, but it is used only in combination with the ELVs because of many practical problems.

Special ELVs, valid only for a limited period of time, are set in the case of special operating conditions such as the initiation of a polluting activity, failure of treatment systems, etc.

3.2 Relation between emission limit values and best available techniques (BAT)

In the BAT approach to pollution control, suitable technology is used for achieving a pre-set environmental target. The technology chosen must be cost-effective with as large a benefit to cost ratio as possible.

Pollution abatement measures based on BAT form a preventive approach in the sense that the techniques are evaluated for their capacity to minimise releases to the environment.

Operation permits are tools with which the competent authorities set environmental criteria for different industries. These permits include environmental conditions related to certain ELV for a specific substance or group of substances. When an ELV is not set at an international level, it must be implemented first by national authorities on the basis of emission limits that can be achieved through BAT, the environmental quality levels expressed as EQO, and through the underlying EOS. Additional analysis must be carried out concerning the effect of emissions on all parts of the environment, including the environmental impacts of additional energy use.

The BAT approach is a reliable way for establishing emission levels that can be obtained through good business practices. For a given activity, the set EQOs allow the competent authorities to decide on the balance between environmental benefit and operating cost, after having considered the impact of that activity in terms of the maximum allowable substance concentration in the environment it causes or likely to cause.

When designing a new installation for a certain activity, the existing environmental conditions of the chosen area must be considered first. If the BAT ELVs are found likely to cause pollution levels in excess of the EQS, the ELVs must be made stricter than those based on BAT ELVs. This means that additional measures must be taken.

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Biographical Sketches

Mr. Alexendros Karavanas received his Diploma in Chemical Engineering from the National Technical University of Athens, Greece, in 1977, followed by a degree in Pharmacology from the University of Athens in 1991.

Currently Mr. Karavanas is working for the Ministry of Environment, Physical Planning & Public Works, Athens, where he is responsible for Environmental Permitting. This involves environmental impact study of industries, granting environmental conditions and permits, corresponding EU legislation, as well as European Community's Support Framework for the Environment. His main duties and tasks include environmental impact assessment of industrial facilities (examination, authorization, setting of environmental conditions especially for the food, pharmaceutical and pesticide industries, tanneries, textile industries, chemical industries etc.).

He has represented the Greek Ministry of Environment (1997-2001) on the European Community's Committee on article 19 of Directive 96/61, "Integrated Pollution Prevention and Control (IPPC)", concerning the inventory of the IPPC industries, as well as on the European IPPC Bureau's Technical Working Group for Food and Milk, Seville, Spain. To date he has participated in several projects of the Greek Ministry of Environment concerning emission inventory of industrial sources in Greece, and implementation of the IPPC system and Best Available Techniques for industry. He has addressed several seminars organized by, among others, the National Technical University of Athens and the University of Athens on environmental issues including environmental impact statement, treatment of waste water effluents, air emissions, pollution control equipment, and impacts from the operation of the food, textile, and chemical industries.

Dr. Michael Christolis is a Civil Engineer specializing in environmental science and technology. Currently he is working as a research collaborator at the National Technical University of Athens (NTUA), Greece, on the mathematical modeling of environmental problems. He has so far accumulated twenty years of experience in air quality monitoring, pollutant dispersion modeling, assessment of the impacts of industrial accidents, design of emergency systems, and implementation of the Seveso Directive in Greece.

During 1983-1988 he was the Head of the Laboratory for the Air Quality Monitoring Network for the City of Athens. In 1988 he joined the Computational Fluid Dynamics Unit (CFDU) of the Chemical Engineering Department of the NTUA, working on research projects on the computational modeling of various applications focusing on environmental issues and problems.

Professor Nicholas C. Markatos obtained his Diploma in Chemical Engineering from the National Technical University of Athens, Greece, in 1967, followed by M.Sc, DIC and Ph.D degrees from the Imperial College of Science, Technology & Medicine, University of London, UK, during 1970 to 1974.

In 1983 Professor Markatos was appointed Director of the Centre for Mathematical Modeling and Process Analysis at the school of Mathematics and Scientific Computing of the University of Greenwich, London, England. At that time he was also a visiting lecturer to the Computational Fluid Dynamics Unit of Imperial College as well as working for CHAM Ltd, (Concentration Heat and Momentum, Limited), London, England. At CHAM he worked first as leader of the Aerospace Group (1976) and then, from 1977 until 1984, as Manager of the Applications Team working on various Fluid Mechanical, Thermodynamic and Transport problems.

Since 1974 he has served as technical consultant to many Research Centres, state institutions and industries.

In June 1980 he was awarded the "Certificate of Recognition" by the Inventions Council of NASA.

In 1985 Professor Markatos was elected Professor of Chemical Engineering at the National Technical University of Athens, and in 1990 he was elected Head of the Chemical Engineering Department. In 1991 he was elected Rector of that University.

Professor Markatos' main scientific interest is in the mathematical modeling of Transport Phenomena, Fluid Mechanics, Thermodynamics and Physical Processes like Fluid Flow (Laminar and especially Turbulent), Heat and Mass Transfer, Environmental Flows, Combustion, etc.

He is referee of scientific papers, reviewer of new books, as well as member of the Editorial Board of several international Scientific Journals.

He has published over 100 original scientific papers in international journals and participated and organized many international conferences, seminars and meetings all over the world. Author of two books, he has also published many articles in the popular press on Engineering Higher Education.