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FINAL REPORT

***Training Course on
Decision Support Systems:
Process Simulation and Optimization Techniques***

*A training course on process simulation and decision support systems
within the framework of the industrial sustainable development*

*Montevideo, Uruguay
14-18 March, 2000*

organized by

ICS-UNIDO

in collaboration with the

Latoratorio Tecnológico del Uruguay, LATU

INTRODUCTION

The background and the motivations for this training course have been outlined in the Aide-Mémoire enclosed to this final report. Therefore, we only summarize the motivations, the justifications and the expected results of the training course on sustainable development process simulation and optimization techniques.

The motivations to organize the course were the following:

- the role of ICS-UNIDO as “knowledge collection centre” in different areas and in the process simulation in particular;
- to facilitate the development of participatory initiatives and direct action in the field of monitoring systems, risk analysis and assessment, and the effective transfer of technology in response to environmental problems caused by industrial activities.
- one of the goals of ICS-UNIDO is the “evangelization” activity in all areas but specifically in the area of sustainable industrial development;
- the need of training people to the use of process simulation and optimization techniques in the decision making environments;
- recognizing the urgent need for developing human resource capabilities, ICS-UNIDO is attaching much importance to the training-of-trainers in the field of process simulation and optimization techniques, with particular attention to the role of such topics within the framework of sustainable industrial development;
- no previous courses on process simulation have been organized in South America and no courses with the set-up of a hands-on complex lab have been done outside ICS.

The course justifications may be summarized as follows:

- "sustainability" is increasingly becoming a key social, political, scientific and engineering issue. Engineers are asked to design new processes and/or by modifying existing processes, aiming at using renewable resources and producing by products that can be returned to the earth in a Sustainable Industrial Development framework;
- process simulation and optimisation techniques can play a dramatically important role in the sustainable development by allowing engineers to conduct process screening and a priori analysis on the feasibility of a given industrial plan, as well as running simulation of performances of waste water treatment and air pollution control.

The specific objectives of the present course were the following:

- to present and critically discuss the necessary background and basic principles necessary to understand and use the informatic tools implementing process simulation, process control and optimization techniques;
- to present an engineering vision of sustainable industrial development;
- to describe and teach “how to use” specific programs by means of demo and “hands-on” sessions;
- to explain how to tackle a simulation problem by showing the sequential steps to be considered in the development of a simulation and optimization strategy;
- to set-up a number of case studies on process simulation within the framework of sustainable industrial development, to be used during the present course, and to be

considered as a set of working examples on real systems to be made available to developing countries;

RESULTS AND DISCUSSION

The general schema and organization of the course is inspired to the tight integration of three different aspects of the process simulation for sustainable development:

- steady state process simulation, in which the goal is the description of the material and energy balance for a given process;
- environmental simulation, in which the Navier Stokes equations are solved for understanding how a given pollutant diffuses in the liquid and gaseous environment;
- Process control that may give a solution for deciding how an environmental control strategy can be established.

Figure 1 - shows this idea and has been used during the course as a reminder of the final goal.

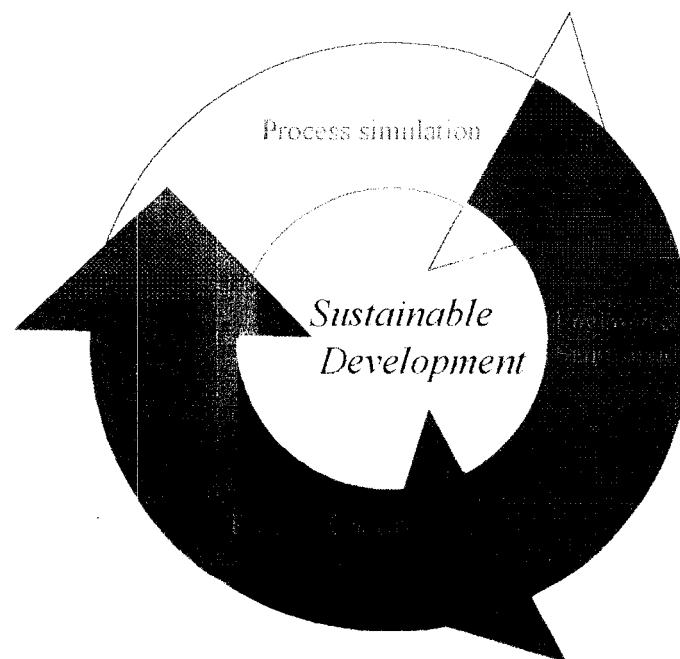


Figure 1: the general schema of the course

The Course was organised in morning sessions in which theoretical and basic subjects have been presented in form of formal lectures by using computer presentations or overheads. Each afternoon (excluded the first day of the course), an electronic workshop session was held in which participants have practiced on fundamental techniques for solving on-the-job problems. Some of the afternoon sessions were also dedicated to workgroup, during which small groups of participants were asked to solve practical problems using the lab that has been set up in LATU, who provided a suitable room, as well as 7 networked personal computers, laser printer, projectors and other equipment for the practical part of the Training Course.

The programme of the course is reported in details in the enclosed document and has been fully respected in timing and in topics during the training course. All the activities were organized under the responsibility of the Programme Officer of the Area of Earth, Environmental and Marine Sciences and Technologies, Mr. G. Longo.

In summary, the first day was devoted to an introduction to ICS activity and specifically to this training course and to a discussion of the concept of sustainable industrial development. The last part of the day was devoted to the fundamentals of process simulation. Due to the rather fundamental topics introduced in this first day, no hands-on session was planned for the afternoon. Specifically, in the module dedicated to the introduction to process simulation an extended presentation of the software by using a PC connected to a projector was used.

The second day of the course was dedicated to the steady state process simulation and environmental applications. General topics of the steady state process simulation were discussed such as the user interface, the data banks available, the thermodynamic modelling and the phase equilibrium models. A good selection of examples of applications has been reported in the field of the environmental protection and sustainable development. In the afternoon a hands-on session was carried out in which small groups performed a simple example of application of a steady state process simulation consisting of a flash and a distillation column, for which it was required the following:

- the calculation of material and energy balance for a “base case”;
- the introduction of a design specification in the distillation tower;
- the introduction of a design specification in the process.

The third day was dedicated to complex systems and industrial applications. The fundamental theory of the multistage fractionation have been presented and discussed. A wide selection of complex case studies have been presented showing how process simulation can help in solving real industrial problems.

Also in this day a very interesting and productive afternoon hands-on session was carried out in the Lab of LATU, in which each group has been provided with a different case study.

The next day, the fourth day of the course, was dedicated to case study presentations and to batch distillation fundamentals and examples.

The last day of the course was devoted to process dynamics and control. The fundamental theory of process control was discussed in the morning and several small examples and exercises were carried out in the afternoon.

All the material showed during the course was distributed to the participants and have been collected (see enclosures). All the exercises and case studies distributed to the participants have also been collected along with the solutions and the relevant files and programs, when applicable. An ftp site has been opened from where most of the presentations can be downloaded (<ftp://ics.trieste.it/pub/montevideo>).

CONCLUSIONS

The Course was directed to technologists, planners and decision-makers working in close contact with industry, particularly engineers, scientists and managers interested in state-of-the-art applications of computer-based techniques for modelling chemical process.

The final selection of the participants was made under the responsibility of ICS Programme Officer and LATU representative, and in accordance with the objectives of the TC and the profile of the candidates. Nineteen participants from Argentina, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Mexico, Panama and Uruguay attended the training course.

In order to have an opinion of the training course by the participants, an evaluation questionnaire was distributed. Some statistics on the comments were prepared and are attached to this report.

In general, participants gained perspective and insight into the potential applications of simulation and optimization techniques, as well as experience in the use of specific computer tools that are currently available.

The formula of the course based on typical lectures in the morning and hands-on sessions in the afternoon has been particularly appreciated by the participants and nicely organized by the trainers, and can be considered one of the most important results of the course.

The informal discussions among the participants and between the participants and the trainers were strongly encouraged by the atmosphere established during the hands-on sessions.

LIST OF ANNEXES

AIDE-MEMOIRE

See attached.

LIST OF PARTICIPANTS

See attached.

FINAL DETAILED PROGRAMME

See attached.

SET OF POWER POINT SLIDES AND COPIES OF OVERHEADS

See attached.

SET OF EXAMPLES

See attached.

STATISTICS

See attached.

FINANCIAL STATEMENT

See attached.