Geophysical Research Abstracts
Vol. 13, EGU2011-13612-1, 2011
EGU General Assembly 2011

Content structure and program development in “Transport and mixing in fluid flow

María José Polo (1), Marta Egüen (2), and Cristina Aguilar (1)

(1) Fluvial Dynamics and Hydrology Research Group, University of Cordoba, Campus de Rabanales, Edificio Leonardo da Vinci, Ingeniería Hidráulica, 14071-Córdoba, Spain (mjpolo@uco.es), (2) Fluvial Dynamics and Hydrology Research Group, CEAMA-University of Granada, Avda. del Mediterráneo s/n, 18006-Granada , Spain (o92egsam@uco.es)

Transport theory constitutes a conceptual basis with many applications in different areas in Science in general, particularly in Geophysics. When the Spanish educational system was modified in 2006 to include official post-graduate master programs from the previous doctorate existing programs, an “Excellence quality” program called Dynamics of Biogeochemical Fluxes and Applications” was transformed into a Ms Degree on Environmental Hydraulics, run by three universities in Andalusia (Southern Spain): Granada, Córdoba and Málaga, who shared a common semester of fundamental subjects and tools followed by separated four different itineraries developed in every university at the second semester.

“Transport and Mixing Processes” was included as a fundamental subject of this first semester. Transport theory provides not only with a conceptual basis ranging from the Reynolds Theorem to the mass/energy transfer due to chemical and biological processes, and phase change , but also with a methodological framework to establish similarities between momentum, energy and mass fluxes, which, focused on the diffusive analogy and introducing turbulence description in a pedagogic manner, makes it possible to understand in depth different processes that may appear differently from a simple analysis but which can be described similarly. In this sense, additional subjects of the common semester, such as Fluid Mechanics, Atmospheric Dynamics, and Aquatic Ecology, rely on this fundamental theory, which is completed during the lessons with introductory topics regarding the most usual applications in Environmental Hydraulics: pollutant transport in waters, geophysical flows, design of treatment for polluted waters, the energy budget in water bodies, etcetera. Moreover, other subjects devoted to frequent tools include the numerical, statistical and experimental methods to deal with the usual mathematical terms and field and lab monitoring systems which are usually necessary to integrate the advection-diffusion equation and associated versions, and calibrate and validate their calculations, under a huge range of conditions.

On the other hand, a continuous evaluation of the learning process is achieved by a highly demanding but at the same time efficient weekly programming. The main core of every topic is introduced during each lesson using audiovisual tools by the teacher; the students have been previously provided with a document where the scheme of the topic, the equations, and the core conclusions are included, leaving blank space to be used by them as handwriting remarks and notes after the explanations. After the lesson, the students must complete individually a set of 4-6 short questions related to the most important points within the next 24 hr; this activity allows both the student and the teacher to know the short-term efficiency of the lesson, and make the necessary corrections. Once the delivery is due, the extended and complete documentation related to the topic is provided, and additional examples must be solved by the students, sometimes in groups, using this material. The results are analysed in the following lesson. An e-learning platform is used as support.

After the Reynolds Theorem lessons and the introduction to momentum, energy and fluid mass transport equations, a block devoted to mass transport in fluids is developed. In parallel, a detailed work on the advection-diffusion equation from the microscopic molecular scale, to the turbulent scales and the space-averaged expressions, is carried out by the students along the first half of the semester, with detailed questions related to different aspects of the arising problems. The conclusions let them develop by themselves the final block devoted to energy transport in fluids, by conceptual and methodological analogies with the mass transport problem.

The 6-yr experience has proven highly efficient to produce in the students skilled competences to describe, analyze and solve many applications in the field of Environmental Hydraulics.