

A METHODOLOGICAL APPROACH TO STUDY THE ENVIRONMENTAL IMPACT OF OIL AND GAS OFFSHORE PLATFORMS

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Abstract

The Central Institute for Marine Research (ICRAM) deals with a monitoring of the eventual environmental impact of the offshore platform activities. Specific monitoring programmes concern the discharge of the Produced Formation Water (PFW) into the sea, the installation operations of platforms and the existence of the offshore structures themselves. In this work we describe the methodological approach for the offshore monitoring used by ICRAM since more than five years.

Keywords : Adriatic Sea, Monitoring.

The oil and gas industry is truly global, with operations conducted in every corner of the world. In Italy there are about 1200 productive wells and 124 offshore platforms, whose 112 in the Adriatic Sea. Oil and gas exploration and production operations have the potential for a variety of impact on the environment. This potential impact may be avoided, minimized and mitigated, through proper tools of environmental monitoring. In particular, with regards to the aquatic environment, the principal problems are linked to the installation of the offshore structure and then to waste streams of drilling fluids, cuttings, well treatment chemicals and produced formation water (PFW). Since 2000 the Central Institute for Marine Research has been carrying on national monitoring plans concerning the environmental impact both of the PFW discharge into the sea and of the installation operations and existence of platforms in the Adriatic Sea, according to national and international protection policies and legislation [1-4].

Our methodological approach matches information on physical, chemical and biotic variables in order to give the best description of the environmental quality status by means of an integrated approach [5]. Through an appropriate sampling strategy we monitor selected chemical and physical variables of water column and sediment, studying the effects on biota and spatial-temporal trend of the eventual alteration that could occur [6-7].

The perforation activities, by the discharge of the water-based drilling fluids and cuttings, and the positioning of a permanent structure may cause effective changes of the chemical quality and physical characteristics of sediment; moreover perturbations on the sea-bottom geomorphology and on the marine living communities could occur. During the offshore production phase water is produced along with oil and gas. This water is called Produced Formation Water (PFW). The PFW discharge impact on marine ecosystem is highly dependent on its quantity, its quality, the characteristics of the receiving environment and dispersion processes.

The extent of the impact can only be judged through specific monitoring activities. The following parameters have been selected for the environmental investigations.

Parameters to investigate
Matrix

PFW

Parameter: BTEX, total mineral oil, aliphatic hydrocarbons, PAHs, phenols, metals, total nitrogen, sulphurs, sulphurate compounds, suspended matter, total organic carbon, nutrients, ecotoxicological assays

Water column

Parameter: current, temperature, pH, salinity, transmittance, dissolved oxygen, chlorophyll *a*, nutrients, total nitrogen, total sulphurs, particulate matter, BTEX, total mineral oil, metals, aliphatic hydrocarbons, phenols, ecotoxicological assays

Sediment

Parameter: grain size, % water, metals, PAHs, PCBs, organotin compounds, total nitrogen, sulphurate compounds, total mineral oil, total organic carbon, aliphatic hydrocarbons, phenols, BTEX, ecotoxicological assays, macrozoobenthic soft-bottom community analysis

Biota

Parameter: fish assemblages analysis, bioaccumulation analysis on *M. galloprovincialis*

Sea bottom

Parameter: bathymetry and morphology

The investigations on water column, sediment and biota matrices allow to study, thus highlighting, the natural features of the marine environment

and then the changes due to the PFW discharge into the sea and to the presence of the offshore structure.

Chemical analysis is known to permit to identify and quantify different single compounds responsible for the environmental contamination, so to give a measure of pollution. Nevertheless, since the chemical approach alone can not provide information about the possible toxicity of bio-available pollutants, it should always be associated to biotic investigations [8]. The monitoring of chemical-physical characteristics of water and sediment, together with ecotoxicological assays, bioaccumulation analyses, macrozoobenthic soft-bottom community structure and fish assemblages study, let to provide the necessary information for assessing the actual spatial and temporal perturbations occurring in the marine ecosystem. Moreover, the acoustic investigations can also allow to map the alterations and to supply the background information necessary for a correct planning of sampling activities and represent the basis for a long-term monitoring study.

The methodological approach presented in this paper is the result of more than five years of experience, gained by ICRAM in the drawing up of the monitoring projects, the performance of the analytical methodologies and the carrying on the monitoring activities. This kind of studies allow us to collect integrated data in order to provide environmental information particularly useful for the public administration and decision makers for the protection of the marine ecosystem.

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