Currently sulfur and Volatile Organic Compounds (VOCs) are the main air pollutants from port areas. The sulfur compounds are responsible for acid rains and some of the VOCs are toxic or carcinogenic. The VOC emissions from petroleum products loading operations constitute around 1% (140,000 t/a) of all VOC emissions in EU. Solutions exist, but their efficiency and/or cost can be improved. Therefore the treatment of the port air is necessary for the protection of the environment and health and to improve safety.

The sources of the different kinds of port air pollutants (e.g. sulfur compounds, VOCs, NOx, ...) are local, and influenced by atmospheric conditions: wind, ambient temperature and humidity.

The innovative solution envisaged in EFFORTS to treat these pollutants is based on the so called photocatalysis technology: It is a low cost, and non selective air treatment solution The technical principle is the following: Gaseous pollutants are destroyed when they are in contact with the catalyst activated by UV light. The catalyst is generally coated onto a support like a filter.
For the stereo systems two systems were selected:

The first one is a projector based passive stereo with colour separation (Projection Design/INFITEC), the second one is a head mounted display system (Cybermind) with tracking system. At the same time the development of a software for double image generation and tracking was completed.

The projector system was tested in May and June 2008 by eight Svitzer tug masters and mates. The initial assessment was that it might help with larger field of view, but the tested versions were not yet adequate. The head mounted display system which provides full view in all directions looks more promising.

Wave effect on tug performance:

Tug assistance to large LNG-tankers operating at offshore terminals is often influenced by wave action, which affects the performance of the tug. Model tests have been performed of direct and indirect steering and breaking the tanker by using the tug in still water and in waves and the results have been implemented in the simulator such that a more realistic tug performance in waves may now be simulated.

Fender effects

When tugs work in waves and push the side of the large assisted ship large vertical friction forces may be generated which may destroy the tug’s fender. Such forces are not considered in present day’s simulators. The task is therefore to develop a fender simulation module which determines both the push force and the longitudinal and vertical friction forces between the tug and the assisted ship. The first part has been to develop the collision detection module and from that to calculate the force interaction and implement that in the simulator.

Efforts test simulator

An EFFORTS test simulator has been set up at FORCE Technology in Lyngby, Denmark, for testing and demonstration of all the functionalities developed under the EFFORTS project.
The objectives of the WP 2.3. Port Air Quality are to identify the main air pollutants and their sources in ports which in practice will be in the Port of Le Havre, to develop and perform the adequate photocatalyst, and to test prototypes on-site, in particular for the treatment of VOCS emitted during petroleum loading operations on the fuel delivering barge MISTRAL.

The impact of the technology on pollution will be then evaluated to allow adapted dissemination of the results. So the aim is the development of an innovative, non-existing, economic and ecologic device for air treatment in relative constringent conditions (explosive atmosphere ATEX, high humidity, dust, saline mist), therefore able to be transferred to other domains.

The results achieved so far is the mapping of the pollutants and pollution sources in Port of Le Havre by bibliographical studies and analysis of existing data, interviews of concerned actors and the analysis of the meteorological aspects in collaboration with Air Normand. This included the identification of activities having impacts on port air quality which at the same time is a contribution of WP 3.1 and the requirements deducted from these findings. These requirements are the analysis of the general situation in European ports, a detailed description of the situation in the port of Le Havre, a legislation overview and an analysis of the benefits of photocatalysis compared to others air treatment technologies.

The analysis in the laboratory of VOCs of one sample of fuel emitted from tanks of a fuel delivering barge and the analysis of data obtained by the "Plan de Protection de l'Atmosphère" (Air Protection Plan) from the Port of Le Havre showed a high concentration of Volatile Organic Compounds. The petroleum pollutants were identified and some of them (i.e. benzene, methanol) are hazardous. All classes of chemical compounds have been identified: Alkenes, alkanes, alcohols. The concentrations and types of pollutants depend on the kind of petroleum products (fuel, crude oil, ...). When the possibilities for practical testing of the prototype under real life conditions were investigated during a visit of the fuel delivering barge MISTRAL it was found out that the fuel delivering barge is an ATEX 1 zone which is the most constringent area for equipment installation where it will not be possible to install the catalytic device as originally planned.

So in a first step the polluted air emitted from tanks will be treated outside this zone next to the berth. Another problem identified is the necessity to filter the air from dust and humidity before it passes through the photocatalytic device. A ecological and economical solution (i.e. a reusable filter) has been found and validated for dust filtering. In a first approach, the photocatalytic devices were composed of 4 reactors, each one comprising of:

- a cylindrical Pyrex glass tube
- 8 UV lamps (outside the glass tube) to activate the catalyst,
- the photocatalytic support (inside the glass tube) shaped to optimize irradiance,
- contact between pollutants and catalyst, and pressure loss. However, this configuration did not get agreement for utilization in ATEX conditions. Another configuration has been proposed and is waiting for its agreement. To test the photocatalytic devices an onflow lab-scale photocatalytic micro pilot for sulfur compounds and VOCs removal was built and different kinds of catalysts for sulfur compounds removal were developed. The test showed a total and stable removal efficiency for 15 ppm H2S for residence times longer than 10 sec and the first 100% solid SO4 selectivity (duration at total sulfur removal) was achieved.

The improvement of the photocatalytic materials efficiency is in progress. A great difference of efficacy has been observed between commercial photocatalysts. Other laboratory catalysts are actually tested. On-site analyses will be performed at the end of November and prototype performance measurements will be done after agreement for utilization in ATEX zone. Other tests will be planned in non-ATEX zone to measure efficiency of photocatalysis on sulfur compounds, particles and NOx.

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Events

- Port Strategy Medtrade Conference, 11. – 12. March 2009, Venice/Italy
Many processes are included already, but to keep the processes up-to-date, input from experts in port operation is highly required. The expected input comprises of process information such as objectives, description of sequential activities, involved parties in processes, etc. This information can be submitted directly through the platform in the comment field. After receiving the information, the EFFORTS Modelling Team will amend the model accordingly.

The platform can be accessed through the official EFFORTS website and the selection of "Port Process" on the navigation pane (See figure 1.1). The EFFORTS PMP is presented in accordance to the port process map developed in WP 3.1 as a tree structure for a better navigation of the map (See figure 1.2).

The users can select whether they prefer to contribute the process information anonymously or involve in the development of this process platform by a simple registration which allows the EFFORTS modelling team to contact for more information and include them in the process expert panel.

We hope that the port process information will be useful for all user groups especially stakeholders of the ports.

Everyone can share his/her knowledge and expertise to improve the process model in EFFORTS. Be a part of EFFORTS for the effective operations in ports!

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