Regulations and Policy of Dispersants Application in Russia.

Dr. Gennady N. Semanov, Head of laboratory “Environmental safety of marine transport”, CNIIMF ltd, St.Petersburg, Russia.

Dispersants are known for about 40 years and only last 10 years widely accepted as effective and environmentally friendly oil spill response tool when they are used properly. Dispersants help the oil slick to spread on the water surface, break it up into small drops (less than 100 μ in size) and transfer into sea water column about 10 meters thick, forming a substance similar to milk. Increasing contact surface of oil with bacteria presented in natural conditions they speed up the natural oil degradation processes many times. The dispersants ingredients surround each drop of oil, keeping them from coalescing and floating back to the surface and sticking to hard surfaces. Satisfactory dispersion of oil in water requires a dispersant-to-oil application ratio (DOR) of 1% to 10%. The sooner the dispersant is applied, the less of it is needed to achieve the desired positive effect.

The first Russian dispersant (OM-6) was developed in 1978; it was followed by the OM-84 dispersant in 1984, which formula included substances increasing oil degradation and took into account a wide variety of practical experience gained from the use of dispersants in real conditions. Simultaneously, a regulatory document defining the procedure for obtaining permits for application of dispersants and using them from ships and aircraft was prepared and approved. A principle of a very careful application of dispersants was proclaimed by this document. It was allowed to use dispersants only in special cases.

This regulatory document is still in force. Experience from oil spill response (OSR) operations indicated that this document and the procedures described therein were out of date, and neither government environmental regulatory bodies nor entities directly involved in OSR were satisfied. The reason was that permits were issued by the central federal authorities without any input from the territorial authorities, i.e., without taking local conditions into account. The entities were dissatisfied because permits were not issued rapidly which would be extremely valuable in an emergency situation. On this basis, in 1998 it was decided to develop a new regulatory document that would:

1. Regulate the application of dispersants in environmentally friendly manner with minimum environmental damage, economic damage and damage to biological resources, as well as time required for issuance of a permit;

2. Take into account all of the latest advances in OSR and dispersant usage;

3. Comply with the requirements and recommendations of international agreements and organizations that Russia is a party to or member of, as set forth in Russian environmental law;

4. Define dispersant-permit application and issuance procedures that take into account the opinions and interests of territorial-level environmental protection authorities, industry, and organizations directly involved in OSR operations.

This document, entitled “Regulations on Oil Spill Dispersants Application” (and hereinafter referred to as the “Regulations”) has been completed and adopted for implementation in October 2005. It was approved by the Ministry of Natural Resources and Federal Agency of Marine and River Transport. Positive opinions and conclusions have been received from the leading institutes for environmental protection and the fishing industry, as well as various research institutes and centers of expertise. The regulations have undergone a State Environmental Expertise Review, as required by the appropriate Russian law and received a favorable evaluation. This evaluation was approved by the Ministry of Natural Resources.

The regulations prescribe the following policy for responding to oil spills:

1. Used technologies must be in compliance with the Russian Federation legal requirements in the field of environmental protection, as well as with all appropriate Russian Federation international agreements;

2. In order to reduce environmental damage and expenses for OSR operations, as much oil as possible should be collected, eliminated, and recovered at sea prior to reaching shore or any natural territories requiring special protection;

3. Mechanical methods for removal of oil from the surface of the water are preferred if the hydrological and meteorological conditions at the spill site permit the use such methods; sorbents shall only be used when the absorbed oil can be removed from the surface of the water in a timely manner (within a single working shift); the use of sinkable agents is banned;

4. When combating large oil spills, all methods (both dispersants and mechanical equipment) for cleanup sea surface shall be used, since practical experience shows that no more than 20-30% of the spilled oil can be collected using mechanical equipment;

5. These various OSR technologies can be applied in parallel: some slicks are treated with dispersants, and some are collected using mechanical OSR equipment;

6. The decision to apply dispersants shall be made solely on the basis of a Net Environmental Benefit Analysis (NEBA) for the regions that have become contaminated or that are under a threat of pollution. Only preliminary approved dispersants shall be used in those cases where results of NEBA indicate that failure to use dispersants will cause more severe impact on biological resources and economic facilities.

Preliminary approval by state nature protection agencies confirms that the dispersant in question has "in principle" been authorized for use in the inland and territorial seas, exclusive economic zone of the Russian Federation and may be included in particular site or regional oil spill contingency plans. The preliminary approval means that dispersant toxicity is tested by Russian specialized research centers and dispersant has duly established maximum permissible concentrations (hereinafter, MPC) for sea areas. The following dispersants are currently licensed for use in Russia and have approved MPC: OM-6 (Russia), OM-84 (Russia), and COREXIT 9527 (US).

The toxicity of oil dispersants is characterized by the acute lethal concentration (hereinafter, LC_{50}), as well as the MPC or approximately safe impact level (hereinafter, ASIL) for fisheries waters.

LC_{50} – the concentration of oil dispersant at which 50% of organisms die in a certain time (24-96 hours, as a rule). This parameter characterizes an acute toxicity and it can be used to screen a number of dispersants for the purpose of selecting the least toxic compound for subsequent practical use. When oil dispersant is applied to an oil slick during OSR its concentration must not exceed LC_{50}

MPC – the maximum concentration of a given compound in the water at which no consequences occur that would reduce the fisheries significance of the body of water.

Planning and justification of the use of oil dispersants, as one possible OSR method should be made in advance when developing the Oil Spill Contingency Plan, hereinafter referred to as “OSR plans” (regional, for a specific port or a specific facility). NEBA for the region in question shall be included (along with a description of the oil spill scenarios considered) in OSR Plan, prepared and approved according to Russian legislation.

The following factors must be taken into account in the planning process and scenarios:

- risk assessment of possible oil spills and the volume of oil spills;
- factors influencing the oil’s behavior on the water (properties of the oil, typical meteorological conditions);
- the sensitivity of the most voluble ecosystem components (VEC) to oil pollution;
- physicochemical characteristics of the dispersants;
- the results of the NEBA conducted according to the Regulations;
- Possession of a properly approved MPC of specific dispersants.

If oil dispersants are applied on bodies of water used for public water supply or recreation, they must have properly approved MPC or approximately permissible levels (hereinafter, APL), which are included into hygienic standards.

The purpose of an NEBA is to prepare recommendations concerning the choice of environmentally and economically optimal oil spill response technique(s) in a real-life situation. An optimal technique is defined as one that will minimize a spill's adverse impact on a region's environment and economy.

NEBA shall include weighting and comparison of the advantages and disadvantages of dispersant use for environmental protection of the area under consideration, as well as an assessment of whether it is possible to prevent significant damage to biological resources. NEBA will include priority levels for protection of particularly rare and valuable species of birds and aquatic animals. Preparation of the assessment of overall environmental benefit shall take into account the fact that fish stocks are restored within 1—3 years, while stocks of plankton are restored within 2—3 weeks, while bird colonies and grounds inhabited by aquatic animals may be permanently destroyed. NEBA is conducted in the stage of preparing OSR plans (preliminary), as well as when a decision is being made at the time of an oil spill (actual).

The Regulations contain as informational material required for preparation of NEBA recommendations concerning methods of dispersant application, monitoring of dispersant effectiveness, sensitivity of various biological resources to oil pollution, and behavior of oil on the surface of the water.

Considering that the dispersability of the oil depends on its properties, the Regulations give information on the dispersability of certain types of oil. If the table does not have the type of oil that is most likely to get into the sea from a given facility, the efficiency of the dispersants must be checked experimentally when planning their use.

The following factors shall be taken into account during preparation of NEBA protocol:

- The list of environmentally and economically valuable components that must be protected on the basis of their priority.
- Seasonal variations of environmentally valuable components.
- Results of oil spill behavior mathematical modeling, the nature of the spilled oil’s and physicochemical changes of it.
- Weather conditions
- The effect of floating and emulsified oil on environmentally valuable components.
- The advantages and disadvantages of different available oil spill response techniques.
- Only preliminary approved dispersants must be considered.

Certain OSR technologies can be immediately eliminated from consideration in a NEBA because they are not effective or usable under the conditions in question; all other technologies shall be ranked by effectiveness and preference. The pro-

posals advanced may include the use of different technologies in different portions of the slick. As far as pollutant dispersal is concerned, the recommendations should also include determination of whether it is or is not feasible to use dispersants in this situation, determination of which sections of the slick are best treated with dispersants, determination of the DOR and description of the measures to be used in monitoring application of the dispersant(s). The results of the environmental analysis shall be documented in an agreed statement and approved by the Incident Commander (hereinafter, IC) and the territorial environment protection agency.

The Regulations include requirements concerning the membership of the NEBA group and the qualifications of group members, as well as during planning stage and actual oil spill. The NEBA is conducted by a group, which must include:

- representatives of the territorial unit of the federal executive agency responsible for environment protection,
- specialists from fishing industry and/or scientific fisheries organizations who are well acquainted with the characteristics of the region or area under consideration;
- specialists in oil spill response technologies;
- specialists in the use of oil dispersants;
- Representatives of agencies of the state sanitary and epidemiological surveillance.

These groups are established in advance by the developer of an OSR plan for a facility or region. The list and names of the experts recruited during actual conditions are approved by the IC of the facility or region.

They should have experience and knowledge in the following fields:

- state of the environment in the area of the accident and the requirements of sanitary and epidemiological surveillance;
- distinctive characteristics of the biology, breeding conditions, habitat and migration routes of birds, mammals, fish, benthic and other aquatic organisms living in the vicinity of the oil spill and adjacent areas; and calculation of the damage to living resources;
- behavior of spilled oil on the water;
- OSR technologies and resources;
- use of oil spill dispersants.

Decision-making on the use of pre approved oil dispersants in an actual situation is made by the IC in agreement with the territorial bodies of environment protection agency -Rosprirodnadsor and water bioresources protection

agency - Rosselhosnadsor on the basis of a NEBA conducted according to the procedure specified by the Regulations.

In the event of an oil spill, a NEBA must be conducted for the actual situation. If a preliminary NEBA has been conducted, the NEBA of the actual situation is done in an abbreviated form. Its purpose is only to make sure that the actual situation corresponds to the scenarios given in the OSR plan, and also to refine the recommendations on the choice of OSR technology (technologies).

On the basis of real-time information, the leader of the NEBA group, who is appointed by the IC, organizes a comparison of the scenarios for which the preliminary NEBA was made to the actual situation at the site of the spill.

If the actual and preliminary scenarios coincide or are similar, the authorized representatives of the territorial units of Rosprirodnadsor and Rosselhosnadsor should endorse the use of oil dispersants in the given situation.

If the actual situation deviates significantly from the preliminary scenarios IC shall convene the NEBA group as quickly as possible and conduct a NEBA to carry out a complete assessment of the actual situation.

Requirements to a technique of dispersant application. When treating oil slick with a dispersant, the initial concentration must not exceed the dispersant's LC_{50}. All dispersants preliminary approved in Russia have equal LC_{50} corresponding to 10 ppm

Calculation of the initial concentration is based on the amount of dispersant applied, assuming that dispersion takes place in a volume of water equal to the surface area of the oil slick to be treated multiplied by a factor of 10 (the depth of penetration of dispersed oil; it may reach 10 m).

It is recommended to used undiluted dispersants, but in practice water solutions of dispersants are sometimes used (usually in a concentration of 10-30%), especially for treating thin films and low-viscosity grades of oil (less than 500 cSt). In this case, a vessel's fire-fighting system can be used, and the dispersant is ejected into the fire main.

Oil dispersants are not recommended for use in enclosed regions of the sea with a low water exchange rate (inlets, lagoons), in shallow waters or when the temperature of the marine environment is below +5°C. Some dispersants can emulsify spilled oil even in icy conditions, but since oil decomposition processes practically cease in winter, dispersants must be used in icy conditions only after a thorough NEBA is effected. In this case, the following factors have to be kept in mind.

Positive:

- There is significant emulsification of water in the oil slick, i.e., formation of highly stable emulsions, particularly in presence of snow. Dispersants will inhibit this process;

- A mixture of oil with dispersant sticks to the fur of marine mammals and the feathers of birds in considerably smaller amounts and is easier to wash off with water.

Negative:

- the efficiency of dispersion of oil into water is low in ice conditions;
- Natural decomposition of the oil is insignificant.

To increase the efficiency of dispersion of a viscous and water content oil slick, it is recommended to use two-stage treatment. The first treatment, for the purpose of de-emulsifying water from the oil slick, is effected with DOR = 1/30, and then 3-4 hours later the treatment is repeated with DOR equal to 1/20. It is not advisable to treat iridescent thin oil films with dispersant.

Assisting tools for oil spill dispersant application.

Sensitivity maps. Oil spill response operations success substantially depends on time required for decision making. In order to reduce it and increase a quality of NEBA a development of environmental sensitivity maps is essential. It is recommended to use GIS for this purposes. Rare species of wild plants and animals listed in the Red Book of the Russian Federation, specially protected natural territories, valuable economic objects and types of shores must be included among the VEC. They have to be shown on maps of the potential sensitivity to oil pollution of resources in the marine area under consideration.

Some coastal areas are more sensitive to oil pollution than others. Factors that determine the sensitivity are e.g. presence of important natural resources, marshes and economic activities. In planning the response to oil spills, an in-depth knowledge of the coastal sensitivities in the threatened area will enable an optimized use of response resources. Furthermore, priorities for protection strategies can be identified through application of maps showing ecological sensitive coastal areas.

The maps must show the seasonal distribution of VEC. The map's explanatory notes shall contain the sensitivity of VEC to the impact of surface and dispersed oil and the priority of protecting them from oil pollution. It is also recommended that the maps indicate areas of the sea where the use of dispersants is inadvisable at any time of the year (for example, fish-hatchery enterprises and facilities, water intakes), where their use is possible in certain seasons of the year, and where dispersants can be used at any time of the year after a NEBA has been conducted (for example, to prevent oil pollution of specially protected natural territories).

In the absence of the maps, the OSR plan must include the characteristics (fisheries, environmental and sanitary-epidemiological) of the sites of possible accidents, which should be obtained from the appropriate regional environmental protection agencies.

Mathematical models of oil behavior on the sea surface. Along with the sensitivity maps, they serve as decision-making tools forecasting zones at risk, direction and velocity of spilled oil (oil slicks) thereby allowing for decisions for selection of strategy and means to be applied for the spill response.

Wide ranges of mathematical models are available today including both forecasting and backtracking features. Some models also offer a three-dimensional approach allowing for evaluation of evaporation/dispersion of the oil depending on the type of spilled oil. The key and crucial issue for all models is the quality of simulation/verification of the local current regime.

Conclusions:

1. Russian Oil Spill Respond Policy foresees use all methods (both dispersants and mechanical) to combat with large oil spills at sea.

2. The decision to apply dispersants shall be made solely on the basis of a NEBA for the regions that have become contaminated or that are under a threat of pollution. Only preliminary approved dispersants shall be used.

3. Only dispersant, toxicity of which is tested in duly authorized Russian research centers, can be considered preliminary approved dispersants.

4. Recommendations on NEBA and requirements to NEBA teams have been included in the Regulations.

References:

IMO, 1995. *IMO/UNEP* Guidelines on Oil Spill Dispersant Application, including Environmental Considerations. pp. 1-55. London.

Baker, J.M. 1995. Net Environmental Benefit Analysis for Oil Spill Response. Proceedings, 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C.pp. 611-614.

Lunel, T., and A. Lewis. 1999. Optimization of Oil Spill Dispersant Use. *Proceedings*, 1999 International Oil Spill Conference. American Petroleum Institute, Washington, DC. pp. 187–193.

Owens, C.F and R. Belore,2004 Dispersant effectiveness Testing in Cold Water and Bash Ice in Proceeding of twenty seventh Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, Environment Canada, Ottawa, pp. 819-841.

Russian Federation Ministry of Transport, 2005, Regulations on Oil Spill Dispersant Application, STO 318.4.02.-2005, pp.29, St. Petersburg (in Russian).