KIMO RESOLUTION 1/02

Presented by KIMO Sweden

POLLUTION FROM TWO-STROKE OUTBOARD ENGINES

Introduction

Two-stroke engines used by many pleasure boats are a major source of hydrocarbon and other toxic emissions in coastal areas. The high emissions from traditional two-stroke engines are caused by the design of the motor. Twenty to thirty percent of the fuel and the added oil that these two-strokes use are emitted unburned directly into the water. At low speeds, up to 40 percent of the fuel entering a cylinder might escape unburned while at the most efficient operating range eight percent of the fuel is expelled as exhaust. A one-hour ride on a boat with a 10-horsepower traditional two-stroke engine emits the same amount of hydrocarbon pollution as driving a modern automobile 40,000km (25,000 miles).

Background

The number of pleasure boats in the North Sea area has been estimated to be in the region of 2 million. Of these, it is estimated that 1 million crafts have outboard two-stroke engines. Approximately 20,000 tonnes (40 million pounds) of hydrocarbons are emitted from this number of two-stroke outboards into water and air every year. At the same time more than 1,000 tonnes (2 million pounds) of unburned engine oil is emitted with the exhaust gases into the water.

It has been estimated that approximately half of the exhaust gases evaporate immediately and the remainder stay in the water for a significant time. The unburned petrol that goes into the air consists of volatile organic compounds (VOC). These hydrocarbons, especially during the summer, help to form ground-level ozone (smog).

The exhaust gases contain toxic compounds to which the vessel users are more or less exposed. One example is benzene from the fuel. The most important two-stroke engine emissions from a health and environmental point of view are the polycyclic aromatic hydrocarbons (PAHs). The addition of motor oil in the fuel results in a highly increased formation of PAHs in the combustion processes and consequent high concentrations of PAHs[1] in the exhaust gases.

While the concentration and effects of exhaust products is minimal in the bulk water column this is not the case in bottom sediments and in the surface microlayer. The surface layer forms the basis of the food chain in many habitats and is crucial to the reproduction of many species. In this layer, as well as in the sediments, hydrophobic organic pollutants such as PAHs tend to accumulate.

A further complication is that some PAHs can become hundreds or thousands times more toxic under field conditions when they are exposed to ultraviolet light in sunshine (phototoxicity). It should also be noted that the recreational use of coastal waters is strongly localised both in time and space and is mainly concentrated to sensitive areas, like shallow coastal areas. Because of this the emissions are likely to cause more ecological damage, than the national average figures might lead one to suppose.

Although not conclusively proven, some researchers are of the opinion that PAHs are the most serious pollutants in the marine environment. Taking this into account it is certain that the PAHs have a potential to damage marine life and it is probable that they contribute to observed negative ecological effects.

With the exception of the 'Bodensee standards'[3], countries in Europe have no specific reduction policy with regard to this pollution source. The effects of these emissions in the marine environment have not been considered in the European policy harmonisation work which is currently being undertaken on European emission guidelines in an amendment to the current Directive (94/25/EC) on the safety of Recreational Crafts.

In order to protect inland and marine waters, it seems likely that more far-reaching measures than those proposed will have to be developed and implemented.

Possible measures

In the longer term the changeover to four-stroke engines or engines with comparable emissions would seem to be a necessary and effective measure. Four-stroke motors, which have been on the marine market since 1972, emit 97% less pollution than conventional two-strokes. Four-stroke motors do not mix oil with fuel and are designed for complete combustion before exhausting. Even the latest direct fuel-injected two-stroke motors emit 10 times as many hydrocarbons as four-strokes. In addition to this, four-strokes are more fuel-efficient and cost-competitive compared to two-stroke motors. The replacement of traditional two-stroke engines with new ones will consequently lead to decreased emissions. The average turnover of two-stroke motors, however, is very slow. Consequently it will take decades before a substantial part of the present two-strokes has been replaced by the need to buy new engines. Because of this more immediate measures are needed.

Examples of more immediate measures that can be employed to decrease the emissions from existing two-stroke engines are the change of fuel from petrol to alkylate[2] and the use of environmentally adapted two-stroke engine oils. In order to promote the use of alkylate fuel in two-stroke outboards, snowmobiles and lawn-mowers the Swedish Parliament on 12 June 2002 decided to lower the tax on alkylate fuel with SEK 1.50. This Resolution has to be approved by the EU.

KIMO Position

KIMO believes that the emission from two-stroke outboard engines should be reduced by appropriate measures in both a long term and a more immediate perspective. It is important to inform boat-owners and users about the problems and risks with two-stroke engine

[3] The Bodensee regulation, effective from 1993 through national implementation in Germany, Switzerland and Austria, regulates the emissions from outboard engines on lakes. Limits are set for emissions of carbon monoxide, hydrocarbons and nitrogen oxides. Traditional two-stroke outboard engines do not meet the demands set by these emission standards.

emissions and possible measures to be taken at the individual level. The changeover to better engines, fuel and oil should be promoted. The marine environment should be considered in the connection with future amendments of relevant EU Directives.

KIMO

Recognising the need for a clean environment in and around Northern Seas and the risks that two-stroke outboard engine emissions pose to coastal marine ecosystems;

Urges;

- **European Governments, the European Commission and others to take vigorous action in order to significantly decrease the emissions from outboard engines.**

- **the European Commission, without unnecessary delays, to further strengthen the limits currently provided for in the Directive (94/25/EC) on the safety of Recreational Crafts and in this context to also consider the impacts of emissions on coastal marine environments;**

- **European Governments to take vigorous and appropriate measures in order to reduce emissions from two-stroke outboard engines.**

KIMO members:

Agree to submit this Resolution to all National Governments, the European Commission and other relevant organisations.

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[1] Polycyclic aromatic hydrocarbons (PAHs) are a large group of compounds that are formed during all types of incomplete combustion of organic matter. They exhibit the characteristic properties of severe environmental pollutants (the so called POPs), i.e. persistence, bio-accumulation, adverse effects and to some extent a potential for long-range environmental transportation.] Many of the PAHs are carcinogenic. And they are believed to exhibit reproductive effects, as well as immune system inhibiting properties, genotoxicity and mutagenecity. Clear effects have been found on fish in all stages of development in areas with heavy outboard engine boat traffic.

[2] Alkylate is a very pure form of petrol. A changeover from ordinary petrol to alkylate fuel is a quick, efficient and cost-efficient method to substantially reduce the negative health and environmental effects of two-stroke engines. The fuel does not contain any aromatics and it will reduce the production of PAHs with 80-90 percent. There will also be reductions of nitrogen oxide emissions with 30-60 percent and the contribution to ground level ozone formation will decrease with approximately 40 percent.