A case for the use of Aspen Alkylate petrol.

Aspen Alkylate petrol will now be referred to as AAP.

AAP meets many company environmental policies that require them to reduce the company's overall carbon footprint and increase employee's safety and reduce the risks of health problems in their working environment.

The main advantages of companies adopting the use of AAP are:-

1, A significant reduction in the exposure to benzene and aromatic hydrocarbons for employees

Which means –

- *Reduced chance of an employee suffering from leukaemia or other related health conditions*
- *Reduced employee sick days*
- *Reduced employee headaches, tiredness, nausea and dizziness*
- *Less downtime from employees, ergo increased production*
- *No longer a requirement for health surveillance under the HSE EH40 WEL guidelines*
- *Conforming to COSHH Regulations 2002 to reduce employee's exposure to Benzene by 'substituting it for a safer material'.*

2, A reduction in the unproductive time spent off site collecting petrol from forecourt fuel stations.

3, Less waste from non usable petrol that was incorrectly mixed.

4, A reduction in machines being damaged from incorrectly mixed 2 stroke petrol.

5, Reduced soot and carbon build up in machines

Which means –

- *Increased service intervals on all machines*
- *Reduced wear and tear on machines*
- *Increased machine life*

6, Reduced waste from fuel “going off”

7, Reduced waste from spillage when using combi can and auto filler solution.

8, Increased economies of scale from high volume purchasing option, due to increased storage life.

9, Stock control and fuel allocation easily managed.

10, Reduction in the company’s/authority’s carbon footprint from reduced toxic and hazardous emissions.

11, Good for employee relations.

12, Good for public relations

Aspen Claims -
Extract from www.aspen.se

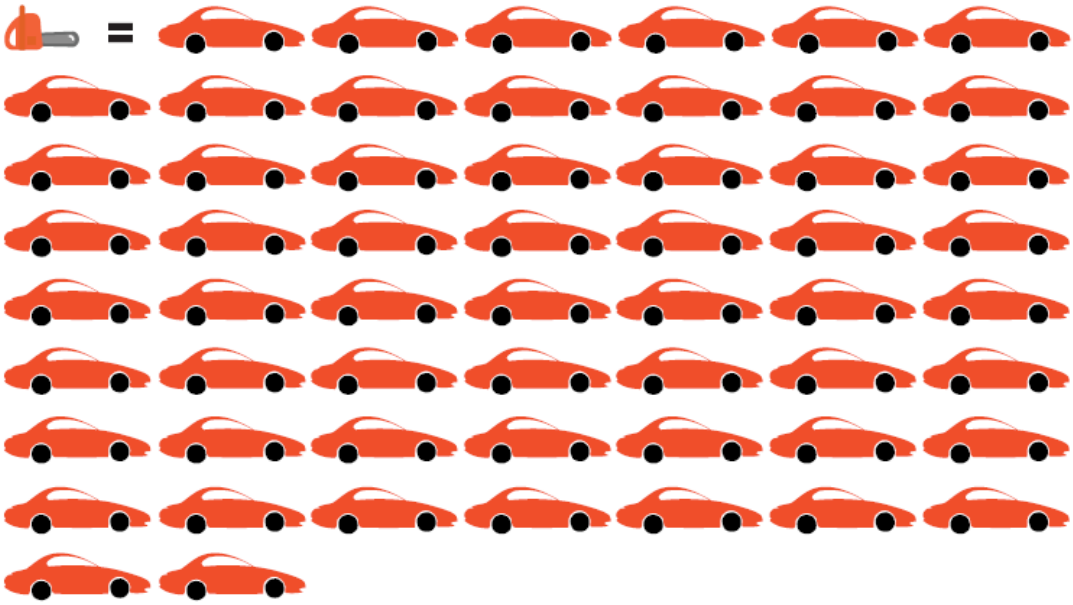
Aspen 2 and Aspen 4 contain virtually no harmful substances such as benzene, aromatic hydrocarbons, polyaromatic hydrocarbons or olefins. Ordinary petrol contains around one hundred substances including these harmful substances, but Aspen alkylate petrol only has around ten of the least harmful. This means that the health risks from exposure to petrol fumes and exhaust fumes are minimised.

Benzene - Causes cancers such as leukaemia and is regarded as the most harmful single substance in petrol and exhaust gases. Becomes concentrated in all living organisms.
Aromatic hydrocarbons - Can cause chronic nerve damage, among other things. Contribute to ground-level ozone (smog). Becomes concentrated in living organisms.

Aspen alkylate petrol – for a better environment

Comparison of benzene emissions between cars and chainsaws

1 modern chainsaw running on normal unleaded 95 octane (RON) petrol is equivalent to 57 modern cars running on unleaded 95 octane petrol.



2 modern chainsaws running on Aspen alkylate petrol are equivalent to 1 modern car running on unleaded 95.

6 chainsaws meeting the 2009 exhaust gas requirements and running on Aspen alkylate petrol are equivalent to 1 modern car running on unleaded 95.

Explanation: The term "modern" is used to mean a 2006 model. The data comes from test of a Husqvarna 346 chainsaw. The car is estimated to emit 0.1g HC/km and to be running at 50 kph.

Comparison table – Typical data

	Aspen 2/4	European 95 octane unleaded
Octane rating RON	95	95
Octane rating MON	92	85
Steam pressure kPa	55–65	70–100
Sulphur ppm	1	10
Aromatic hydrocarbon content vol%	0,1	35
Benzene content vol %	0,01	1
Olefin content vol %	0,1	5–18

Note – Aspen conforms to European Standard EN 228 for Unleaded Petrol.

The following information will act to back up Aspen Claims -

Comparison between Aspen and Total Unleaded petrol (UL95).

Aspen Safety data Sheet

15. REGULATORY INFORMATION

Symbol(s)

Contains	Fullsynthetic twostroke oil Naphtha (petroleum), full-range alkylate benzene Naphtha (petroleum), isomerization
Risk phrases	R-11 Highly flammable. R-38 Irritating to skin. R-53 May cause long-term adverse effects in aquatic environments. R-65 Harmful: may cause lung damage if swallowed. R-67 Vapours may cause drowsiness and dizziness.
Safety phrases	S-2 Keep out of reach of children. S-23 Do not breathe gas/vapour. S-24 Avoid contact with skin. S-62 If swallowed, do not induce vomiting: seek medical advice immediately and show the container or label. S-61 Avoid release to the environment. Refer to special instructions/ Safety Data Sheets. S-16 Keep away from sources of ignition - No Smoking.
EU directives	67/548/EEC, 1999/45/EC, 2001/58/EC, 2008/58/EC (REACH), 1272/2008/EC (30ATP).

Ordinary Pump Fuel Safety Data Sheet

15. REGULATORY INFORMATION

Symbol(s) :

Symbol(s) :	T Toxic F+ Extremely Flammable N Dangerous for the environment.
Contains :	Gasoline
Risk phrases :	R-12 Extremely flammable. R-38 Irritating to skin. R-45 May cause cancer. R-46 May cause heritable genetic damage. R-51/53 Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment. R-63 Possible risk of foetal harm. R-65 Harmful: may cause lung damage if swallowed. R-67 Vapours may cause drowsiness and dizziness.
Safety phrases :	S-2 Keep out of reach of children. S-16 Keep away from sources of ignition - No Smoking. S-23 Do not breathe vapour. S-24 Avoid contact with skin. S-29 Do not empty into drains. S-45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S-53 Avoid exposure - obtain special instructions before use. S-61 Avoid release to the environment. Refer to special instructions/Safety Data Sheets.
EU directives :	Hazardous preparations directive 1999/45/EC modified (Directive 2001/60/EC). D. 67/548/EC modified by D. 2004/73/EC (29th ATP)

Note - ordinary petrol is labeled Toxic, Dangerous for the environment and included phrases R45, R46, R51, R63, S29, S45, S53. None of which are present on the Aspen safety data sheet.

ALKYLATE PETROL

Environmental Aspects of Volatile Hydrocarbon Emissions

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ABSTRACT

All hydrocarbons emitted from production and use of petrol are hazardous to human health and the environment, but to a different extent for individual compounds. This thesis compares and characterizes C_2-C_8 hydrocarbons related

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petrol. Major advantages of the alkylate petrol were found to be low proportions of benzene, alkylbenzenes and alkenes in the fuel. The compositions of fuel alkanes and combustion-formed alkenes differed markedly for the two fuels.

3. HAZARDS OF DIFFERENT HYDROCARBONS

Petrol consists of a mixture of a large number of hydrocarbons, and during combustion additional compounds are formed. Different hydrocarbons have different impacts on human health and the environment, and the hazards of specific hydrocarbons, or at least groups of hydrocarbons, must be considered. The main hydrocarbon groups in petrol are alkanes (paraffins and naphthenes), arenes (aromatic hydrocarbons) and alkenes (olefines). Beside alkanes, conventional petrol contains a high percentage of arenes and alkenes (Table 1). Alkylate petrol consists almost entirely of alkanes.

3.1 Human health hazards

Major acute health effects of high exposure to volatile hydrocarbons are effects on the central nervous system. From this aspect, arenes are regarded to be more hazardous than alkanes (Axelson and Hogstedt, 1994). However, as ambient air pollutants, volatile hydrocarbons have been paid most attention as cancer risks (Möller et al., 1994). Table 2 shows two different estimations of cancer risks for individual volatile hydrocarbons. For a discussion of different approaches and results, see Törnqvist and Ehrenberg (1994).

One of the arenes, benzene, is classified as a human carcinogen by the International Agency for Research on Cancer (IARC, 1987). Benzene is contained in petrol as well as formed due to incomplete combustion. The alkenes ethene, propene and 1,3-butadiene are combustion-formed, but not contained in petrol. They are of special toxicological interest due to metabolic formation of genotoxic epoxides (Victorin, 1993). 1,3-Butadiene has proved to be carcinogenic in animal tests. A part of inhaled ethene (~5%) is converted into ethylene oxide (Törnqvist, 1994), which is judged to be a probable human carcinogen (IARC, 1985).

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5. VAPOUR AND EXHAUST EMISSIONS

Since alkylate petrol consists of the least hazardous hydrocarbons, both to human health and the environment, the use of alkylate appears to be advantageous compared with conventional petrol. However, the composition of petrol vapour

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varies depending on the refinery processes used. It is seen that the proportions of the benzene, alkylbenzenes and alkenes are low for the alkylate fuel. Furthermore, due to a lower vapour pressure[2], the total emission of petrol vapour during refuelling, and consequently also the amount of hydrocarbons inhaled, should be lower for alkylate compared with conventional petrol.

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to health hazards from petrol exhaust. Benzene is almost absent in the alkylate petrol. During combustion, benzene is also formed in smaller amounts than from conventional petrol. The proportion of alkylbenzenes is low in alkylate petrol.

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region near to the emissions. The low content of these hydrocarbons in alkylate petrol is therefore advantageous from an environmental point of view.

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Worldwide, almost all alkylate presently produced is mixed into petrol for automobiles. However, alkylate as fuel for small engines has shown remarkably improved exhausts in several emission studies (**V**, Hare and White, 1991; Hare and Carroll, 1993; Nilsson, 1988). Considering the fact that alkylate is desireable

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Alkylate replacing conventional petrol do not decrease the total hydrocarbon emissions, but less hazardous hydrocarbons are emitted (**VI**). This

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6.2 Location and time of emissions

Pollutants from small engines are often emitted near to people, which results in high exposure concentrations. For example, before switching to alkylate petrol, Swedish forest workers using conventional petrol for their chain saws were typically exposed to benzene concentrations in the range 300-1800 $\mu g/m^3$ (Nilsson et al., 1987). As a comparison, during urban/suburban commuting in Sweden, benzene levels of 30-70 $\mu g/m^3$ inside the car have been reported (Barrefors and Petersson, 1993; Löfgren et al., 1991[b]). Similar levels have been reported in US studies (Chan et al., 1991; Lawryk and Weisel, 1996; Wallace, 1989; Weisel et al., 1992). Furthermore, many small engines, such as garden tools and outboard engines, are mainly used during the critical spring and summer photooxidant season. When the location and time of emissions are considered, human health and environmental arguments for using alkylate for small engines are therefore strengthened.

6.3 Professional and private use

Originally, alkylate petrol was introduced in Sweden in 1989 for professional forest workers using chain saws (Nilsson, 1988). Today, it has acquired a solid position within professional forestry. About 90% of the chain saws and most of the swirl cut saws are fuelled by alkylate petrol. Also for small engines used in parks, public places and cemeteries, the use of alkylate petrol is increasing rapidly. On the private market, alkylate petrol is most frequently used by farmers and private forest owners. Alkylate petrol accounts for more than half of their working machines. For garden equipment, the market share is smaller, and for outboard engines and scooters, an ethanol-blended alkylate-based petrol has recently been introduced.

In Sweden, the consumer price is today 1.5-3 times the cost of conventional petrol. For private use, the high price probably constitutes the

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In professional applications, the price is often less important. For an employer, the extra cost of more expensive petrol is normally small compared with the total cost for the employee, and there are also Swedish occupational health proclamations supporting the use of the least hazardous fuel.

7. THE FUTURE OF ALKYLATE FUELS

Telling the future is a difficult challenge. A variety of unpredictable factors may change the scenario. Nevertheless, in spite of uncertainties, a scenario of the future will hopefully stimulate interesting discussions. Therefore I conclude my thesis with a sketch of the future production and use of alkylate in Europe.

7.1 Alkylate for small engines

In countries with high environmental awareness, the use of alkylate petrol in small engines should gradually replace conventional petrol within the next few years. The health and environmental benefits compared with conventional petrol are convincing and the present production of alkylate appears to be more than high enough to supply most small engines with fuel. As in Sweden, the change is likely to start with professional users of utility engines, primarily because they are heavily exposed and because the high price of the alkylate petrol is not as critical for them as for private users. On the private market, fiscal incentives

of global warming in the long run. Consequently, the environmental optimum would probably be for a reasonably large part of today's most hazardous petrol components to be replaced by increased production of alkylate and other less hazardous petrol components during the next decade, and for all fossil petrol components to be phased out during the next century.

HOW CAN BENZENE AFFECT YOUR HEALTH?

Extracts from Benzene and You - Published by the Health and Safety Executive INDG329 10/04

Benzene can be absorbed into your body:

- if you breathe in air containing benzene vapour;
- through your skin; and
- if you swallow material containing benzene.

The effects on your health depend on how much benzene you are exposed to, and for how long. Immediate effects of high exposure can include:

- headache;
- tiredness;
- nausea; and
- dizziness.

Unconsciousness may occur if exposure is very high. Long-term exposure to benzene can result in serious blood disorders such as anaemia and leukaemia (a form of cancer).

WHAT PRECAUTIONS SHOULD YOU TAKE?

If you could be exposed to benzene at work, you should:

- ask your employer about the risks, what precautions to take and what to do in an emergency;
- follow the safe working procedures laid down by your employer;
- avoid breathing in vapours containing benzene;
- avoid getting liquids containing benzene on your skin;
- use the ventilation equipment and personal protective equipment provided, eg gloves, masks, goggles. Gloves should be made from materials which resist penetration by benzene. Natural rubber gloves should **not** be worn as rubber absorbs benzene;
- report to your employer or safety representative any damaged or defective ventilation plant or protective equipment; and
- where required, attend any health checks arranged at your workplace.

WHAT DOES THE LAW SAY ABOUT WORKING WITH BENZENE?

Work with benzene is subject to the **Control of Substances Hazardous to Health (COSHH) Regulations 2002**

Your employer is required to:

- assess the risks to your health and provide control measures to protect you;
- prevent your exposure to benzene, eg by eliminating its use or substituting a safer material, or if this is not reasonably practicable, to adequately control your exposure;
- reduce so far as is reasonably practicable the amount of benzene you breathe in, and in any case to keep it below the maximum exposure limit* of 1 ppm averaged over an 8-hour working day;
- establish the extent of exposure, normally by means of a monitoring programme;
- arrange any appropriate health checks;
- give you information on the risks of exposure to benzene, and train you in the use of any equipment, including personal protective equipment, used to control your exposure; and
- make sure that any control measures and personal protective equipment are kept in good working order.

Extracts from -

The Control of Substances Hazardous to Health Regulations 2002 (as amended) Approved Code of Practice and guidance - ISBN 978 0 7176 2981 7

Regulation 7 Prevention or control of exposure to substances hazardous to health

(1) Every employer shall ensure that the exposure of his employees to substances hazardous to health is either prevented or, where this is not reasonably practicable, adequately controlled.
(2) In complying with his duty of prevention under paragraph (1), substitution shall by preference be undertaken, whereby the employer shall avoid, so far as is reasonably practicable, the use of a substance hazardous to health at the workplace by replacing it with a substance or process which, under the conditions of its use, either eliminates or reduces the risk to the health of his employees.

Prevention of exposure

89 An employer's overriding duty and first priority is to consider how to prevent employees being exposed to substances hazardous to health by all routes (regulation 7(1) and 7(2)). Employers who do not first consider this are failing to comply with a fundamental requirement of the Regulations. The duty to prevent exposure should be achieved by measures other than the use of personal protective equipment. Employers can best comply with this requirement by eliminating completely the use or production of substances hazardous to health in the workplace. This might be achieved by:
(a) changing the method of work so that the operation giving rise to the exposure is no longer necessary; or
(b) modifying a process to eliminate the production of a hazardous by-product or waste product; or
(c) substituting wherever reasonably practicable, a non-hazardous substance which presents no risk to health where a hazardous substance is used intentionally.

Regulation 10 Monitoring exposure at the workplace

(1) Where the risk assessment indicates that –
(a) it is requisite for ensuring the maintenance of adequate control of the exposure of employees to substances hazardous to health; or
(b) it is otherwise requisite for protecting the health of employees,
the employer shall ensure that the exposure of employees to substances hazardous to health is monitored in accordance with a suitable procedure.

Table 1 The employer's duties

Duty of employer relating to:	*Duty for the protection of:*		
	Employees	*Other people on the premises*	*Other people likely to be affected by work*
Assessment (regulation 6)	Yes	SFAIRP	SFAIRP
Prevention or control of exposure (regulation 7)	Yes	SFAIRP	SFAIRP
Use of control measures and maintenance, examination and test of control measures (regulations 8 and 9)	Yes	SFAIRP	SFAIRP
Monitoring exposure at workplace (regulation 10)	Yes, where requisite	SFAIRP	No
Health surveillance (regulation 11)	Yes, where appropriate	No	No
Information, training etc (regulation 12)	Yes	SFAIRP	No
Arrangements to deal with accidents, incidents and emergencies (regulation 13)	Yes	SFAIRP	No
SFAIRP = So far as is reasonably practicable			

"carcinogen" means –
(a) a substance or preparation which if classified in accordance with the classification provided for by regulation 4 of the CHIP Regulations would be in the category of danger, carcinogenic (category 1) or carcinogenic (category 2) whether or not the substance or preparation would be required to be classified under those Regulations; or
(b) a substance or preparation –
(i) listed in Schedule 1, or
(ii) arising from a process specified in Schedule 1 which is a substance hazardous to health;

"hazard", in relation to a substance, means the intrinsic property of that substance which has the potential to cause harm to the health of a person, and "hazardous" shall be construed accordingly;

"mutagen" means a substance or preparation which if classified in accordance with the classification provided for by regulation 4 of the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 would be in the category of danger, mutagenic (category 1) or mutagenic (category 2) whether or not the substance or preparation would be required to be classified under those Regulations;

"*substance hazardous to health" means a substance (including a preparation) –*
(a) which is listed in Part I of the approved supply list as dangerous for supply within the meaning of the CHIP Regulations and for which an indication of danger specified for the substance is very toxic, toxic, harmful, corrosive or irritant;
(b) for which the Health and Safety Commission has approved a workplace exposure limit;
(c) which is a biological agent;
(d) which is dust of any kind, except dust which is a substance within paragraph (a) or (b) above, when present at a concentration in air equal to or greater than –
(i) 10 mg/m$_3$, as a time-weighted average over an 8-hour period, of inhalable dust, or
(ii) 4 mg/m$_3$, as a time-weighted average over an 8-hour period, of respirable dust;
(e) which, not being a substance falling within sub-paragraphs (a) to (d), because of its chemical or toxicological properties and the way it is used or is present at the workplace creates a risk to health;

References –

- The Control of Substances Hazardous to Health Regulations 2002 (as amended) Approved Code of Practice and guidance - ISBN 978 0 7176 2981 7
- HOW CAN BENZENE AFFECT YOUR HEALTH?
  Extracts from Benzene and You - Published by the Health and Safety Executive INDG329 10/04
- Ulf Ostermark Doctoral Thesis 1996 on Alkylate Petrol
- European Standard EN228 Ref No. EN228:2008: EHSE EH40/2005 Workplace exposure limits
- Total UK Safety Data Sheet
  Product name : UNLEADED RACING GAZOLINE / UNLEADED SPECIAL GAZOLINE
  SDS n° :33889-44 Version :1.00 Version of :2004-04-15
- Aspen Alkylate Petrol Material Safety Data Sheet 33666 - Aspen 2 Revision date: 2009-09-15
- www.aspen.se
- www.hse.co.uk