THE SMOKE REPORT DESCRIBES THE VARIOUS PROCESSES USED TO GENERATE SFX SMOKES FOR THE FILM AND TELEVISION INDUSTRIES.

IT COVERS THE SAFETY ASPECTS OF EXPOSURE TO SMOKE PRODUCTS AND DETAILS SPECIFIC EQUIPMENT AND SMOKE MATERIALS.

THE SMOKE REPORT IS INTENDED TO BROADEN UNDERSTANDING AND KNOWLEDGE OF SFX SMOKE PRODUCTS AMONGST ALL INDUSTRY MEMBERS.

THE SMOKE REPORT

THE HANDBOOK OF SPECIAL FX SMOKE PRODUCTS FOR THE FILM INDUSTRY

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TABLE OF CONTENTS

ABOUT THIS REPORT:

Smoke is probably one of the most commonly used Special effects on a movie set, and also possibly one of the least understood by those who are exposed to it. Over the years I have been approached many times by fellow technicians who are both concerned and interested in the products that are used in Special Effects smoke products. Typically they have wanted to know what ingredients are used to produce the smoke and what health hazards they might face from exposure to them.

As a result, several years ago I decided to further increase my knowledge of this subject so I could answer any queries others might have had about Special Effects smokes.

I started an information file on many of the smoke products that we use in Special Effects work, and when possible I would consult with Chemists and Doctors for specific information.

Having seen the effects of ignorance cause people on set to be in some cases needlessly concerned, and in others incredibly lax about certain smoke products, I felt there was an increasing need to provide crew members with reliable information to dispel unnecessary concerns .

This report is not intended for one group in the Film Industry but to provide Grips, Gaffers, Make-up artists, Safety Officers, Production Managers —in fact, all members of a

Film crew with the information and answers to questions they may have about Special Effects smoke products and equipment. To achieve this, copies of this report will be made freely available to all Industry members through the Australian Film Commission and various other organizations.

I have attempted to keep explanations in layman's terms, where possible. The technical jargon used by Industrial Chemists and in many of the Material data sheets is confusing to the uninitiated and I have found tends to obscure understanding, rather than increase it.

It is my hope that this report will dispell the myths and rumours that surround this subject, by providing useful information for the reader, and lead to improved working conditions on the set.

Alan Maxwell

The costs involved in research and Study for this report were partially funded by the Australian Film Commission.

I wish to thank Cathy Robinson, Director of Cultural Activities at the Australian Film Commission, for supporting the production of this Smoke report, by providing me with a Travel Grant to study Specialized Smoke Products and equipment in Los Angeles.

RIGHT-TO-KNOW LAWS:

Many of the products we deal with in Special Effects work are dangerous and potentially harmful. But used with care and correct handling, can be utilized on Film sets with safety.

Special Effects smoke products and equipment have been in use in the American Film Industry considerably longer than they have here in Australia, so I have found it useful to look towards the U.S. situation and see what steps for protection and safety they have implemented.

I certainly like to know the health hazards of materials I am dealing with. I also believe that other Crew and Cast members have the right to know what potential hazards they are being exposed to, and should have the opportunity to take correct protective measures where necessary.

It is that Right-to-know that has become a generic term in the United States for federal, state and local laws that collectively set out to accomplish three primary objectives:

1) To determine the dangerous properties of substances used or produced in the workplace.

2) Right-to-know laws mandate that employers and employees must be educated to recognize and properly handle hazardous substances.

3) Thirdly, the laws force managers to disclose the presence of hazardous substances to employees and customers so they are aware of potential exposure hazards; and to public authorities to ensure communities are aware of the potential dangers of a hazardous substances released in the environment.

In the United States one of the main keys to the success of the Right-to-know laws is a printed form known as a MSDS (Material Safety Data Sheet) This form provides a variety of information concerning hazardous substances, such as the chemical and common names, (if the substance is a mixture then the hazardous components are identified individually).

The physical and chemical hazards of the substance, its flashpoint and its potential for fire, explosion, and reactivity with other materials.

The health hazards of the substance are noted, how to deal with exposure to a particular hazardous substance, such as first-aid procedures and how to recognize signs of exposure.

Information is also given for the safe handling and use, as well as approriate procedures for clean up of spills and leaks.

By giving employees and members of the public ready access to these MSDS forms, they can quickly find out what materials they are dealing with and what potential exposure risks they might stand.

SPECIFIC DATA ON SMOKE FLUIDS:

Wherever possible I have obtained copies of Material Safety Data Sheets and other specific information for many of the water and oil based smoke fluids mentioned in this report.

For those of you who like to sift through technical information you will find this data in the reference section at the back.

TESTING:

To determine the hazards of exposure to various chemicals laboratory animals are often used as test subjects.

These animals are usually rats, rabbits and dogs.
Tests are conducted for eye and skin irritation and to determine the lethal dose through ingestion of these products.

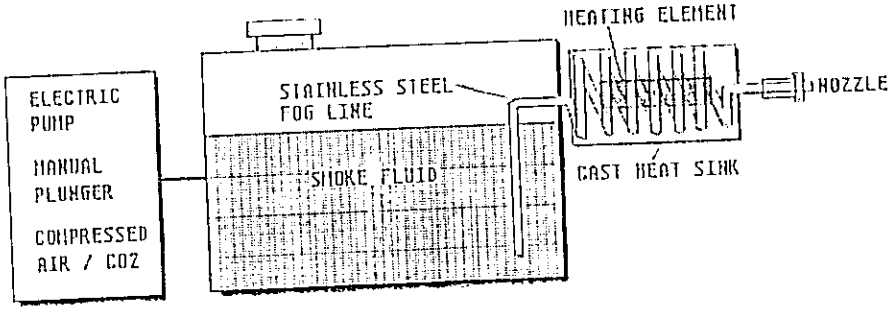
The LD(50) — an abbreviation for the lethal dose necessary to kill 50 per cent of the population of the test animals is expressed as grams of chemical to kilogram of body weight.

Some of the MSDS forms will contain this information.

WHAT IS SMOKE ?

Smoke produced through most Smoke Machines is actually an aerosol. A cloud of tiny liquid droplets, so minute in size that they drift through the air, carried by the smallest wind currents.

BASIC WORKING PRINCIPLE OF SMOKE MACHINES



Liquid smoke fluid, is drawn from a solution tank and pumped through a heat sink or heat exchanger. The liquid is rapidly heated above its boiling point, thus vapourizing it, (process of converting a liquid to a gaseous state). The expanding vapourized smoke fluid builds up considerable pressure and is discharged through a small diameter nozzle into the atmosphere. This process atomizes the vapourized smoke fluid into hundreds of thousands of tiny droplets, creating what is technically referred to as an aerosol.

Depending on the machine used the smoke particles can vary in size from 0.5 up to 75 Microns. (A micron is a millionth of a metre). In order to give you an idea how small that is, a single strand of human hair measures approximately 100 microns.

Small Smoke Machines tend to produce fine particles, ranging in size from 0.5 – 25 microns. They can consume anything from 0 - 6 litres of smoke fluid per hour.

Medium sized units like Swing Foggers produce particles between 0.5 - 50 microns in size and consume from 8 to over 40 litres per hour.

Large machines in the Mega Fogger class produce particles between 0.5 and 75 microns in size with a variable output of 57 to 456 litres per hour!

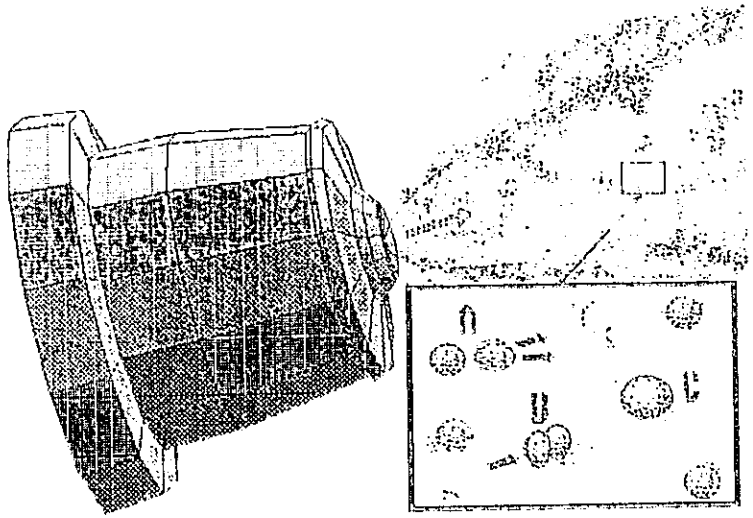
There are two main types of smoke fluid, water based and oil based. The oil based smoke fluids are usually highly refined mineral oils. Water based smoke fluids are a blend of glycols. I will be discussing these fluids in more detail in an upcoming chapter.

DROPLET MECHANICS

When the vapourized smoke fluid is ejected from the nozzle of the Smoke Machine the individual particles or droplets take on a spherical form.

How quickly they do this is dependent on the surface tension of the aqueous solution.

The lower the surface tension, the smaller the particle size. glycols used in water based smoke fluids have quite low surface tension properties. For example, water has a surface tension value of around 70 dynes/cm. The glycols are around 45 dynes/cm. Wetting agents are around 30 dynes/cm.



ATOMIZING NOZZLE OF A SMOKE MACHINE

The atomized droplets tend to rise as they are shot out of the Smoke Machine because they are usually hotter than the ambient air temperature.

The droplets are carried aloft by small air currents and convections. Where smoke concentrations are highest the individual droplets bump and collide with each other.
(See diagram above)

On collision with each other the droplets will either change direction (A) or merge in the case of (B) and form larger droplets (C).

Some of the smaller super-heated droplets do not last long. They evaporate, (turn to a gaseous state) in the atmosphere. One of the properties of glycols is that they evaporate many times less quickly than say water. Binding water with glycols produces an aerosol that lingers longer.

As the smoke overall loses its heat, the heavier aerosols will descend. Once smoke has filled an enclosed space, like a room or studio, there is a limit to how much smoke can be absorbed into the atmosphere. Once the air is saturated, the aerosols condense and settle to the floor. Maintaining a light airflow will help reduce this effect.

By nature smoke fluids tend to be slippery viscous substances. When the droplets settle on surfaces that they come into contact with they leave a minute film of slippery liquid.

When smoke concentrations are high or the particle size is large the resultant film is likely to be more noticeable.

Another property of glycols is that they are hygroscopic, meaning that they absorb water out of the atmosphere. This is an important point to remember as I will illustrate later in the section on respiratory hazards. Glycol mists have been used overseas to increase humidity in greenhouses (due to their water absorbtion properties) and also to diffuse the sun's rays as they enter the greenhouse.

SMOKE EFFECTS ON THE SET

Who is responsible for creating Smoke Effects on set ?
When the requirements are small it is usually the Props men. In the earlier days of Australian filmmaking the Props men were also responsible for creating many of the Special Effects.

A number of Standby Props carry a small Smoke Machine with them or the dreaded Bee Smoker.

As complexity of a scene or amounts of smoke required increase, an Effects man is usually consulted or brought in.

Logistically, creating exterior smoke effects is difficult, as you are always at the mercy of Mother Nature. Fogging large areas requires many machines and assistants. In recent years on Australian films with a large number of SFX scenes, we have seen the development of Atmosphere Crews who are purely responsible for fog, smoke or mist effects.

So it is studio interiors or small exteriors that become the domain of the Props men. Why pay the cost of an Effects Operator when you have your Props man and Smoke Machine standing by ? It is usually here that film crews are exposed to consistent and sometimes very high levels of smoke over long periods. If the Props man is knowledgeable and is using safe products this situation probably presents little hazard.

SMOKE EFFECTS ON THE SET — CONTINUED

Unfortunately, there are some Props men in the Industry who still advocate use of Bee Smokers and use toxic, and harmful smoke products on sets without really knowing what they are.

I was a visitor to one film set where the Props man intended to set off a military smoke pot in a fairly small studio with limited air circulation.

I was greatly concerned and discussed the matter with him and the First A.D., informing them both of the toxicity of that particular Smoke. Unfortunately, they did not heed my advice and within minutes I was joined outside by an entire crew who coughed and choked on the fumes of a smoke pot they simply should not have been exposed to.

This is not to say that I want to see toxic or dangerous Smoke products banned from use but rather correct handling and understanding of them.

There are products like A/B Smoke that are acidic and burn the respiratory tract. But given proper care and respiratory protection, A/B Smoke is an excellent product for achieving certain Special Effects that can not be produced by other means.

It would be easy to become paranoid about many of the chemicals that surround us in everyday life and on set, it is important to retain a sense of perspective. Banning products is, in my opinion, not the solution to the problem.

SMOKE PRODUCTION:

There are a large variety of smoke machines, smoke materials and methods of smoke production currently available to us. smoke devices have been developed for agricultural, entertainment, military and scientific applications. Many of the machines and smoke products used in Special Effects work have been adopted from these other Industries.

It is simply not possible to mention every smoke machine or product manufactured so I have endeavoured to represent each major type and system.

In particular I have examined some recent systems for smoke production which are still relatively new to us in Australia. Such as the Mee Pure Water Fogger, this system does not so much simulate fog but actually create it !

I have also looked into what may become a possible future system for smoke generation, using ultrasonics.

Not everybody will want to read all the details about the various smoke processes, so I have covered the general aspects of smoke production and safety first, followed by more in-depth information on individual products and pieces of Equipment.

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WATER BASED SMOKES:

These smoke fluids are normally used in the smaller portable and studio smoke machines. They can be used in medium and large sized smoke machines but usually are not due to cost considerations. Water based smoke fluids cost between $ 12.00 - $ 22.00 per litre. Due to a very high flash point they are regarded as non-flammable.

The actual ingredients used in water based smokes are kept fairly quiet by the major companies that sell them. Since they have spent time and effort in developing these products, they tend to be guarded about the details of their compositions. They rely largely on advertising material to appease our concerns about harmful effects.

There are several different water based smoke fluids available through local suppliers that are cheaper than imported fluids. Some of these smoke fluids are equivalent to overseas brands and others are not as safe, due to the presence of certain undesirable chemicals.

Water based smoke fluids generally consist of a blend of various types of water soluble glycols, some water, a dye for colour and a perfumed scent — both of the latter ingredients serving no useful purpose other than for aesthetic reasons.

Propylene glycol has featured predominantly in many different water based smoke fluids. Propylene Glycol is a

viscous, colorless, odourless liquid that has been subjected to thorough testing, it is non-irritating to eyes and skin. Propylene Glycol is not expected to be hazardous to the health through inhalation and is deemed safe for Human consumption by the U.S. F.D.A (Food and Drug Administration). One of its main commercial uses is as the syrup in liquid medicines. It is also used in pet foods to keep the contents moist.

Unfortunately, a smoke fluid based purely around Propylene Glycol does not last long in the atmosphere, it produces a thin smoke which dissipates rapidly. To counter this, other Glycols are usually added to increase the longevity of the smoke. In some cases ones that don't boast the same safe features of Propylene Glycol.

One glycol that has been used in water based fluids and is now considered unsafe for use is Monoethylene Glycol. It can be simply referred to in abbreviated form as MEG.

Monoethylene Glycol (also known as Ethylene Glycol) is a dihydric alcohol, it is both colourless and odourless. It has hygroscopic properties, meaning it absorbs water from the air. It has a high flash point of 110 celsius or (230 degrees F).

Ethylene Glycols have been with us since the late 1930s. They were used in the Merlin engines of the Spitfire aircraft in World War Two due to their ability to transfer heat well and work over a very wide range of temperatures.

Monoethylene Glycol is poisonous if swallowed, and can lead

to liver and kidney damage. Its health risk to humans has been clearly documented.

Its presence in some Austrian wines several years ago lead to a public outcry after it produced kidney damage in some consumers of the wine. The glycol was used to give an immature wine a more full-bodied taste and feel to the mouth. Propylene Glycol was supposed to have been used in its place.

There was another case where monoethylene glycol was found to be used to dilute a cheap Spanish Olive oil.

COMMERCIAL APPLICATIONS:
Due to a low freezing point Ethylene Glycol is frequently used as a principal component in vehicle anti freeze solutions. It is also used in Brake and various Hydraulic Fluids.

Other Glycols that are used in Water Based Smoke Fluids

Diethylene Glycol (DEG)
This glycol is derived from monoethylene glycol and can contain small quantities of MEG. For this reason it is not advisable to use smoke solutions containing DEG.

Diethylene Glycol is also a colorless, odourless liquid. Although it shares similar properties to monoethylene Glycol it has a higher boiling point 244.8 degrees C as opposed to 197.6 C.

It is both irritating to eyes and skin and poisonous if swallowed in large quantities.

COMMERCIAL APPLICATIONS:
DEG is used to remove water moisture in Natural Gas lines.

Triethylene Glycol (TEG)
Also a colourless, odourless, highly hygroscopic liquid. TEG closely resembles the properties of Diethylene Glycol but is considered to be of much lower toxicity. Like DEG it, too, is formed from Ethylene Glycol and Ethylene Oxide. However, it is unlikely to contain MEG and is regarded as the safest of the three glycols. Flash point is high at 154 degrees celsius. Boiling point is 287.4 degrees C.

COMMERCIAL APPLICATIONS:
Because TEG is an efficient hygoscopic agent it has been used in air freshener products to remove odours from the air.
It is also used to remove moisture from tobacco in the cigarette industry. I was also told by a doctor that TEG has been given to women in labour as a mild pain reliever. (inhaled)

Polyethylene Glycol (PEG) (See data Sheet)

OVERHEATING OF GLYCOLS
Glycols heated in air above 175 degrees C will tend to breakdown. They will definitely breakdown above 200 degrees C and surface charring will occur above 295 degrees C.

Overheated glycols have a sharp acrid smell but are unlikely to become toxic. This was a concern I had after noting the acrid smell generated by Smoke Machines that are left on heat without use for long periods of time.

OIL BASED SMOKES:

Mineral and Paraffin oils are generally used in conjunction with gas operated smoke machines or larger smoke machines such as Swing Foggers, for exterior use.

Some smaller smoke machines are capable of operating on oil based smokes. If used to any extent on interior sets they will act as a laxative.

Caution must be used because these machines run at high temperatures. Invariably, the fluid can ignite with little warning, producing flame from the discharge nozzle.

MOBIL WHITEREX 108
No longer available, was often used in Special Effects smoke applications, now it has been replaced by WHITEREX 307.
The new formulation is a more highly refined oil. The old 108 did have a noticeable petroleum odour and I found it to be quite irritating. It is possible that there are still some supplies of this product in use.

MOBIL WHITEREX 307
Higher grade medicinal quality oil. Not produced in Australia, but is imported from America.

SHELL ONDINA 15
A non-toxic medicinal quality oil used on machines that come in contact with food, it is also used as a massage oil. Ondina

is odourless, tasteless and surpasses USP requirements for Neutrality, Sulphur compounds, Solid Paraffins and Carbonisable substances. Ondina is non-irritating to eyes and skin. This highly refined petroleum product is produced in Australia. I recommend the use of Ondina 15 for exterior use in thermal Smoke Machines and in Cracker Foggers for interior use. Ondina is a pleasure to work in when it is generated as smoke from a Cracker Fogger, it is truly non-irritating, even over long periods of use.

DIESEL

Diesel oil will run through most of the medium to large Smoke Machines but should never be used where personnel have to breathe the resultant smoke without respirators.
Inhalation of diesel smoke can produce chronic pneumonia of the lungs.

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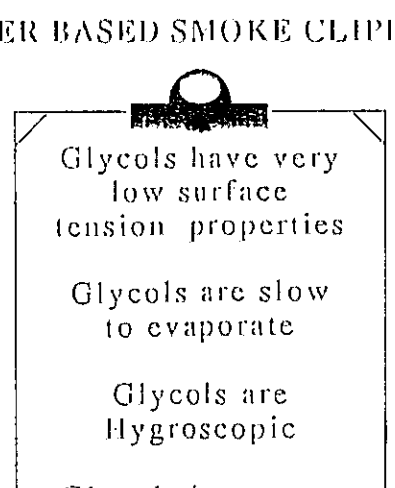
WATER BASED SMOKE CLIPBOARD



RESPIRATORY AND HEALTH HAZARDS:

Most of the toxiological information available on the chemicals used in smoke fluids are based on tests conducted with laboratory animals. Usually figures given relate directly to the results of ingestion, and skin and eye irritation. However, this information does not relate to the most common form of Human exposure to smoke fluids, which is as an aerosol and by way of inhalation.

Sensitivity to smoke products will vary with the individual.

As is the case with both water based and oil based smoke fluids it is important that any individual with breathing problems such as asthma take precautions not to expose themselves to high concentrations of smoke as this may cause reaction.

Dust particle masks, or handkerchiefs will do little to filter smoke. If protection is required, respirators equipped with organic vapour cartridges should be used.

It is worth noting that film crew who smoke cigarettes are probably doing themselves more damage through smoking than they are likely to achieve through exposure to smoke fluids.

Water based smoke fluids that use formulations of Propylene Glycol and or Triethylene Glycol are referred to as GRAS Generally regarded as safe. Tests have revealed no real

adverse effects. For further detailed information please read the report to the National Association of Broadcast Employees and Technicians in America. A series of tests was conducted on a variety of smoke products and the results are shown.

We can look to other Industries for cases of health problems that have arisen due to inhalation of micro mist oils. Ethylene Glycol was used in hydraulic fluids for the roof jacks used in underground mining. Its use in this application and others, such as lubricating oils on high speed lathes, has been halted. Inhalation of excessive amounts of liquid paraffin or diesel oil can produce chronic pnuemonia of the lung. In the case of mineral oils which are chemically inert, the lungs are capable of removing these rapidly.

The use of aerosols as a technique for administering medicines is developing. In some cases the absorption of medicines via the lungs is said to be superior to results achieved through ingestion. The stimulant effects of cigarettes are achieved this way, through absorption in lungs.

As we know, one of the key properties of the glycols used in water based smoke fluids is that they readily absorb moisture from the air. If a studio or interior set contained noxious fumes it is quite conceiveable that if water based smoke was then dispensed in that area, the smoke aerosol would absorb these vapours which, in turn, could be easily inhaled and absorbed into the lungs of any persons breathing in that area.

As research progresses into the health hazards of cigarette smoking, so increases the understanding of the effects of Passive smoking, (Non-smokers developing health problems from breathing exhaled cigarette smoke.) Though I know of no evidence to support this theory I feel that there could be increased risk of absorbing harmful cigarette smoke by-products through people smoking on sets filled with glycol smokes. Only research and testing will be able to produce conclusive results at this stage.

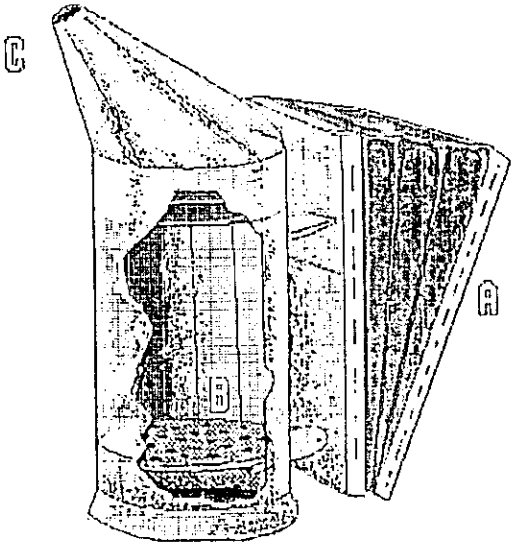
Water miscible Smoke particles larger than 20 microns in size will not enter the lungs. They will largely be filtered out through the nose and upper respiratory tract. The particles to enter the lungs would be the finest of all, certainly under 10 microns in size, probably around 5 microns.

OTHER HAZARDS

FAX

Not the machine but a little known hazard of smoke production I certainly hope I never get to see. FAX is a military abbreviation for Fuel Air Explosive. This is a particularly nasty device which is dropped by aerial means, it blows at low levels above the ground, dispersing a cloud of unignited fuel in the air. Once the fuel mist dissipates to the correct ratio with air, a second charge fires, detonating the entire cloud with incredible intensity.

Water based smoke fluids have very high flash points. In fact, they are regarded as non-flammable liquids. However, in the same way it is possible for the dust in grain silos to lead to explosion. Overfogging of enclosed spaces can produce conditions that lead to a fire or explosion.



BEE SMOKERS:

For many years Bee Smokers have held favour with Cameramen and D.O.Ps for the fine, light smoke they produce. Bee smoke is less of a problem in exterior scenes but is most often used to create the effect of cigarette smoke in night clubs or bar scenes. Because Bee Smoke is generated through combustion it produces sore eyes and headaches when used in enclosed surroundings.

These units were originally designed for bee keepers to narcotize bees whilst they removed the frames of honey.

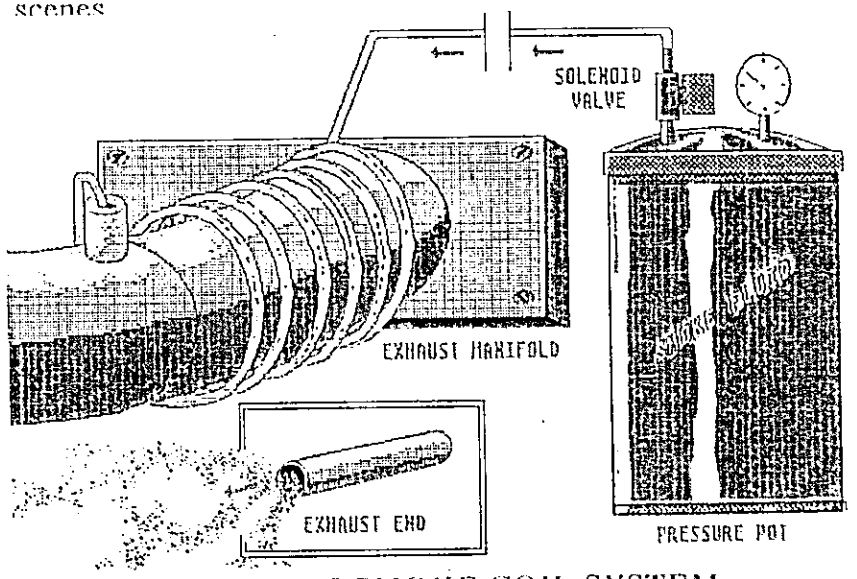
Bee Smokers produce smoke by pumping air, via a hand operated bellows — (A) through a small combustion chamber (B) —containing heated charcoal tablets and chunks of rosin or incense powder. The resultant smoke is forced out through a small metal funnel —(C) into the air.

HAZARDS:

Bee smoke produces sore eyes and headaches and is quite unpleasant to work in. Some Props men insist on using gum leaves and twigs instead of Ecclesiastical Incense. This is an archaic way of producing smoke on film sets.

THE ALTERNATIVE

The fine light smoke effect of Bee Smoke can be accurately produced through the use of oil crackers on interior or studio scenes



SIMPLE SMOKE COIL SYSTEM

This simple system is sometimes used on Wind-Machines to provide addtional smoke facility. A stainless steel or copper fogline is run from a pressure pot, to a point high up on the engine's exhaust manifold. The smoke fluid, usually oil based is pre-heated as it passes through a coil wrapped around the

exhaust pipe. The fluid is then injected into the exhaust system where it is further heated and broken up. Flow of the fluid is controlled by a 12 volt solenoid or by manual means. Systems like this are often used on aerobatic aircraft to produce smoke trails during displays.

MOLE RICHARDSON/
MADEWELL SMOKE MACHINE:

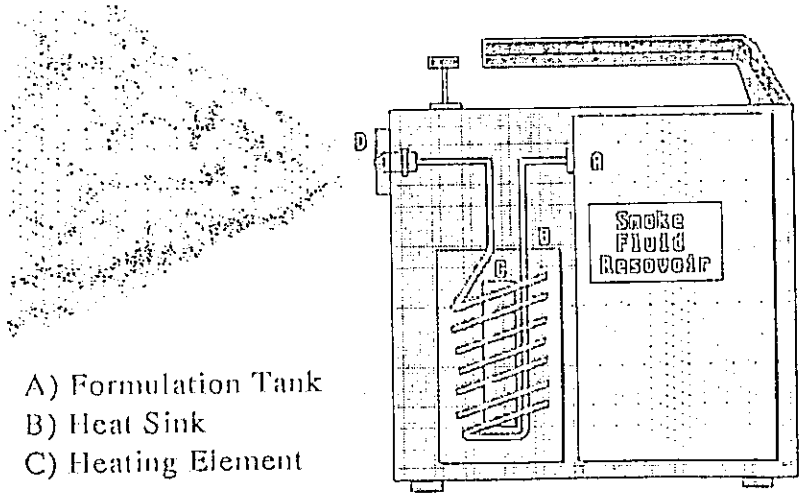
There are a few of these American machines in Australia. They are an excellent unit. However, the changes from the 110 to a 240 volt model seem to result in a variety of electrical problems, which can lead to spectacular melt downs. These units are housed in dark brown/black art deco style bakelite cases.

Originally manufactured by U.S company Madewell for dispensing insecticides. Mole-Richardson Co. then became agent and distributor to the Film Industry. They seem to be very popular "workhorse" model in the States where many Effects men modify them for expanded capacity and continuous use. The basic model the type 1963 Fogmaker has been in use for over twenty five years !

OPERATION:
These hand held units are electrically powered (8 minutes to heatup) and manually operated. Smoke fluid is pumped via a thumb operated plunger through a brass heat sink, vapourized and shot through a special atomizing nozzle. Like many good things, the system is simple, it works well. Because they use a brass heat sink they will operate off power for several minutes.

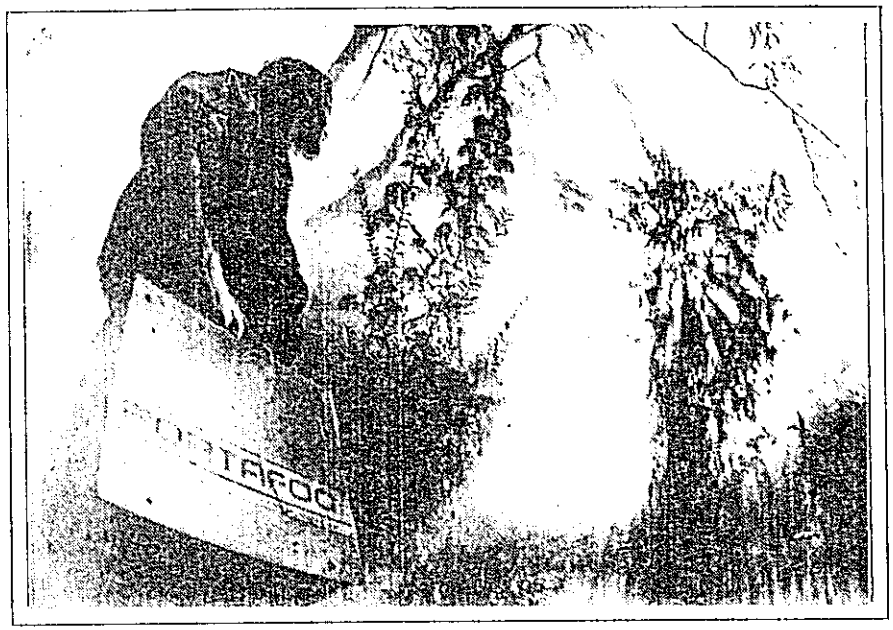
FOG FLUID:
The Mole Foggers will work equally well with oil based and water based fog fluids. As always I would recommend use of approved water based fog fluids for studio or interior use.

ADDITIONAL FEATURES:
Mole Richardson also provide a fog cooler attachment which mounts on the front of the Smoke Machine and produces a psuedo dry ice effect. The fog cooler is simply an aluminium cage that, once filled with dry ice pellets, chills the smoke passing through it and causes the smoke to drop to the floor. Like dry Ice, chilled fog lasts longer when the floor or ground is cold and wet. As the smoke warms back to ambient room temperature it becomes ragged and rises. The one advantage of using this system is that the ground fog effect lasts much longer than dry ice which needs to be constantly replenished.



A) Formulation Tank
B) Heat Sink
C) Heating Element

STANDARD SMALL ELECTRIC SMOKE MACHINE



PORTAFOG

The Portafog is an excellent portable smoke machine with a very impressive smoke output for its small size. Its performance never fails to amaze those who see it in operation. It was built to incorporate the best qualities of other units with increased ruggedness and an ability to take the knocks of use in film. What's more it is Australian made !

The Portafog can run both oil types it is available as a manual (Model 301), remote (311), and remote variable (312) units. The Portafogger has been adopted for use by the Australian Navy and is also used by the Fire Brigade for training purposes.

SWING FOGGERS!

These units operate using the same principle as the V-1 Flying Bombs used by the Germans against the English in World War Two.

Known as Pulse Jet engines they operate (on the principle of the Schmidt-Argus tube) by feeding air and fuel into a combustion chamber and igniting it at over 80-100 times per second generating an unmistakable sound that makes Swing Foggers instantly hated by Sound Recordists !

Smoke fluids fed into the jet-tube are broken up by the hot pulsating gas stream and quickly vapourized, generating clouds of smoke.

APPLICATIONS:

Swing Foggers are normally used in agriculture for dispensing fungicides in greenhouses or disinfecting stables and chicken sheds.
In tropical regions, pesticides are frequently used in Swing Foggers to curb malaria by killing off mosquito colonies.

OPERATION:

A horizontal, manually operated plunger simultaneously pressurizes the fuel tank and pumps smoke fluid from its tank down to a nozzle at the end of the Jet-tube and into the hot airstream. Ignition of fuel is achieved with a buzzer coil and spark plug, once the unit has started it self-sustains combustion so long as it is getting air and fuel.

The generation of smoke is manually operated by a valve on the formulation tank or via a solenoid valve.

There are several models of Swing Foggers available produced by companies such as Pulsfog, Curtis Dyna-Products, Igeba and Swing Fog.

Swing Foggers all generate quite large amounts of fog and smoke. Several Foggers can cover quite large exterior scenes.

IGEBA TF 30

An improved version of the Swing Fog is produced by a German Company Igeba. The original inventor of the Swing Fog set up his own company and produces this superior model which is not prone to the regular breakdowns of the Swing Fog.

Primarily the TF-30 has been designed for applying water or oil soluble insecticides and fungicides.

Roger George in the U.S. makes an attachment for the IGEBA which allows the Swing Fog to produce coloured smoke. This unit injects a stream of liquid smoke pigments into the hot airstream.

SMOKE FLUID:

Swing Foggers will work with a wide range of smoke fluids both oil based and water based. They will even produce smoke from diesel fuel. Oil based smokes are more than often used for two reasons. Firstly due to the high rates of fluid consumption (up to 40 litres per hour) water based smoke fluid becomes extremely expensive at $12- $22 per litre. Also due to

the high running temperatures of these machines, over heating water based smoke fluids produces a thin smoke which tends to rise and dissipate more rapidly.

Swing Foggers can be adjusted to operate with water based smoke fluids, and I would recommend this where Swing Foggers are to be used on interiors or studios situations.

HAZARDS:
Swing Foggers become incredibly hot over long periods of use. Sometimes to the point where they stop vapourizing the smoke and start combusting it, this creates a convincing impression of a flame thrower.

If the machine is shut down before the smoke fluid supply valve is switched off, invariably it will ignite the smoke oil. The hot oil then drips, flaming like a fireman's drip torch, igniting anything combustible it lands on.

Personnel should keep clear of the jet-tube on all Swing Foggers in case they flame-out. There really is no warning as to when this will occur.

When these machines are being used in enclosed spaces, care must be taken not to overfog them. Swing Foggers are capable of large output, overfogging a room could produce a fire or explosion hazard. An airflow should be maintained at all times.

Water based smoke fluids are to be preferred for interior use in thermal smoke machines over oil based smokes.

ROSCO SMOKE MACHINES:

Rosco laboratories first released their Water Based Fog Fluid in late 1979 and followed with the introduction of the model 8211 Smoke Machine in 1980.

OPERATION:
On switching fog on, smoke fluid is sent through a variable output pump to the heat exchanger (an aluminium unit with built in element) from there the vapourized smoke is shot out of the nozzle.

In practice the Rosco Fog machine suffers a few problems, they are prone to breakdowns. The nozzle is so fine that unless the fluid is kept filtered clean they block up. The unit does not take kindly to being tipped over on its side during operation.

In the course of use on film sets, smoke machines are put through very rugged situations, they need to be able to take the knocks and abuse.

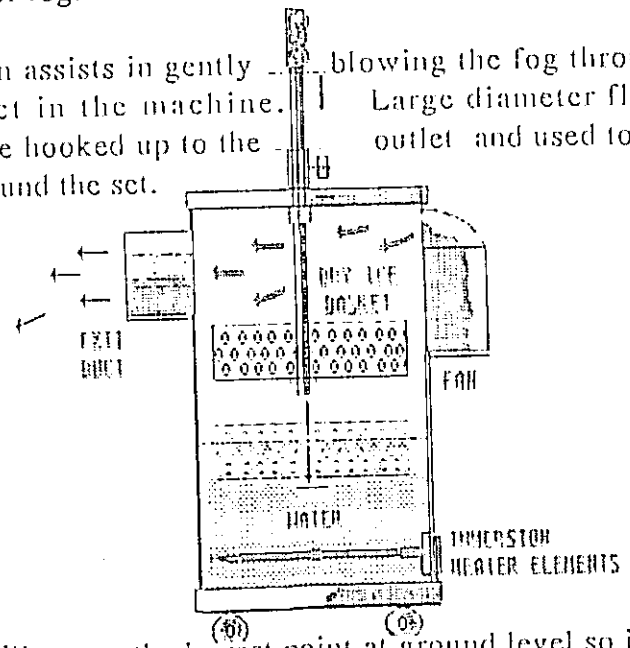
The unit is claimed to be portable, but in practice it is a little oversize and strangely shaped, making it awkward for portability on the set. The other point that restricts mobility is that there is no heat sink in the Rosco, so you are always tied to a power cord. When the power is off you cannot produce any smoke at all.

DRY ICE:

When pellets or chunks of dry ice are immersed in hot water they produce voluminous clouds of low hanging fog. This effect is mainly used in Stage and Theatre productions or in films as the cliche fog-in-the-cemetery effect.

A simple dry ice machine is shown below. Electric immersion heaters are used to boil water in the drum, when required the dry ice basket is lowered into the water, liberating large quantities of fog.

A small fan assists in gently blowing the fog through an outlet duct in the machine. Large diameter flexible hose can be hooked up to the outlet and used to direct the fog around the set.



The fog will run to the lowest point at ground level so in order to buildup any depth of fog a "fence" needs to be built to retain the fog in the shooting area. Care should be taken in the handling of Dry Ice as it can cause frostbite, also because the

cloud is Co2, if you were to lay in the fog you would immediately have difficulty breathing, because it excludes oxygen.

MEE II PURE WATER FOG MAKER

Roger George a U.S. Effects man who owns what is probably the largest Special Effects rental house in America, revealed to me the interesting tale of how he first came across the system.

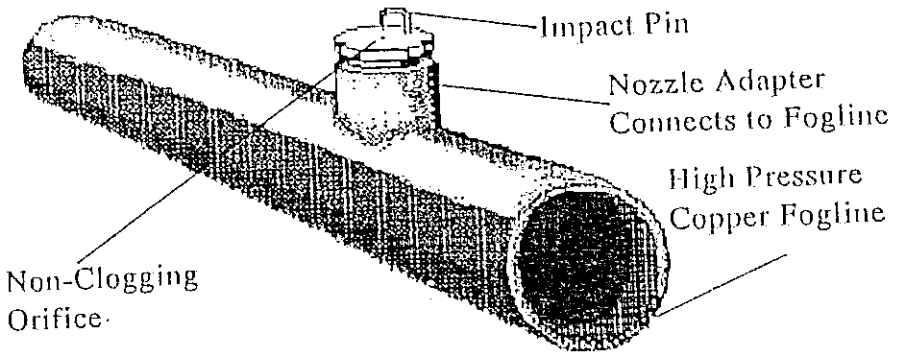
The Mee system was originally developed for agricultural purposes. Roger read an interview with the inventer in Time magazine and realizing its potential application in Special Effects subsequently contacted him. Roger is now an agent and distributor of the system for the Film Industry.

The Mee Pure Water fog maker is a modular system which is supplied in four differant models, each comprising a high pressure pump, control manifolds, 1/2 " high pressure hose and between 10 - 22 quick connect Fog Lines.

The Fog Lines are 1/2" brass tubes five feet long with 6 special Mee nozzles or six feet long with 10 Mee nozzles. The fog Lines quick connect for easy set up and disassembly.

OPERATION:
The Mee Fogger takes ordinary water, filters it several times then pumps it at 1000 PSI down through the interconnecting manifolds and hoses to the special nozzles on the fog lines. The nozzles jet the water out of an extremely small orifice to impact with a specially designed pin and is broken up into ultra-fine water droplets. The individual droplets are so small

they float on air the same way real cloud and Fog droplets do. They only measure about 10 microns in diameter.



IN PRACTICE-

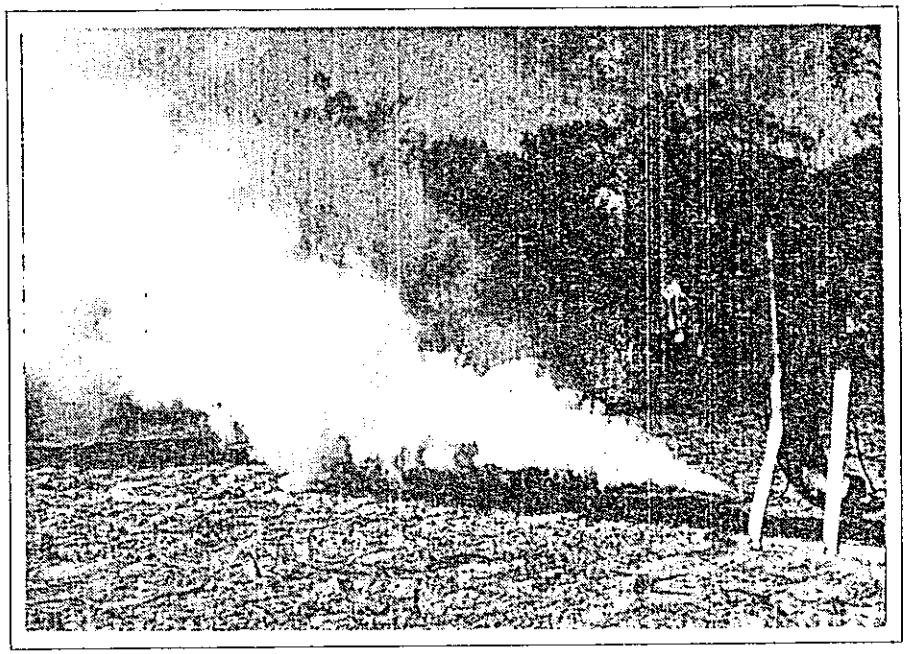
I was fortunate enough to see the system in use at BOSS FILMS in Los Angeles recreating the look of a primeval forest for an upcoming IMAX production.

The system really works and useful applications abound. Mee fog simulates steam beautifully. It also simulates dry ice fog extremely well and can be combined with normal smoke. The effect stops very quickly after it is switched off, and because it is water, Mee Fog does wet the immediate area around the fog lines.

Roger George told me he installed a large Mee system in the garden of American TV personality Johnny Carson to cool his guests in the heat of summer.

Roger has recently installed a special Mee Fog rig at Universal studios on a propane truck that is seen by visitors to the

"Earthquake '89" Tour. The truck issues clouds of "gas" courtesy of Mee Nozzles and an odourant which smells like the actual odourant used in propane gas.



JA JA FOGGER IN OPERATION

The Ja Ja fogger is a gas operated Smoke Machine which owes its name to Camp Ja Ja in Kakadu National Park. The original Ja Ja fogger was assembled by Special Effects man Chris Murray from "found" objects around the ex-mining Camp.

The beauty of this particular machine is it is simple and it works extremely well. The Ja Ja is capable of continuous Swing Fog output with little noise. It is best suited for exterior use with oil based smoke fluids. Its mode of operation is

similar to the Smoke coil system depicted on page 25.

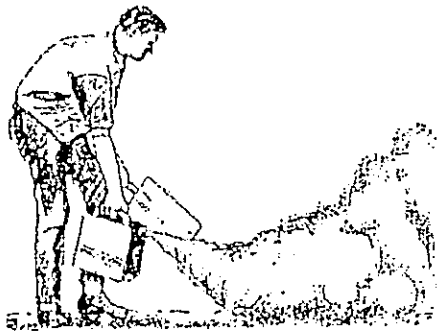
These types of units are also sometimes referred to as "London Foggers". Many Effects men have their own personal versions of gas operated foggers, the units often vary in size, output and effectiveness.

HAZARDS:
Gas operated fog machines generate a lot of heat and constitute a fire hazard. Like Swing Foggers they can drip or throw flame without warning.

Overheating of oil based smoke fluids can irritate those exposed to the resultant smoke. Care should be taken to maintain adequate but not excessive heat levels.

As with Swing Foggers and Megafoggers, where Gas Foggers of a large output are being employed in enclosed spaces, care must be taken not to overfog these areas. Although slight, there is an increased possibility of fire or explosion.

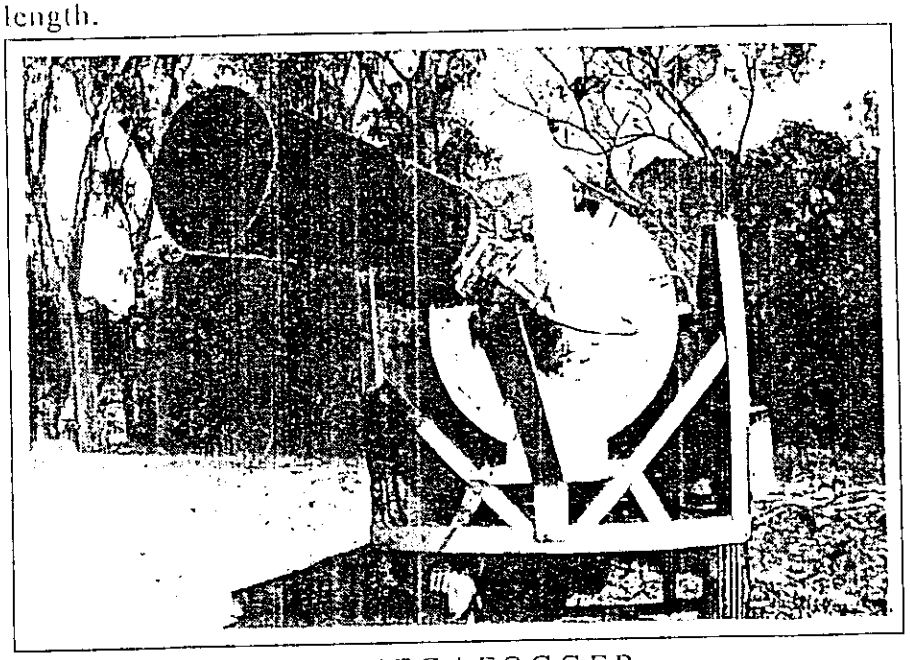
Wherever possible air flow should be maintained throughout the set.



MEGAFOGGER

To the best of my knowledge there are only two of these units used in the local Film Industry. The first, a Dynafogger 1200 was imported from the United States in 1984.
The other unit was Custom built by Neville Maxwell in 1987.

Megafoggers have a capacity for absolutely enormous output. On a still night at Essendon Airport in Melbourne we managed to generate a cloud of smoke that was over a kilometre in length.



THE MEGAFOGGER

The Megafoggers can use both water and oil based smoke

fluids but once again economics usually dictate the use of cheaper oil based fluids.

Particle size of the aerosol smoke is variable between .5 and 75 microns, although it is generally closer to the higher value. There is a noticeable fallout of the larger particles in the area in front of the units during operation.

MEGAFOGGER Starting to discharge Smoke

Because the particle size is so high it is very unlikely that the smoke will enter the lungs, the majority will be filtered out in the upper respiratory tract. Also, because these foggers are predominantly used outside, constant exposure to very high levels of the smoke is likely to be much less than that of a smaller smoke machine on an interior set.

Generally the Megafoggers are mounted in a trailer or on a vehicle or boat, along with drums of smoke fluid so they can be quickly moved in position to compensate for wind shifts.

HAZARDS:

As far as Smoke Machines are concerned Megafoggers are the most complex to operate as they require almost constant monitoring of temperature and fluid levels. Megafoggers should only be used On-set by experienced operators.

As previously discussed, overfogging of enclosed spaces should be avoided. The following is a series of excerpts from the operating manual for the **Dyna-Fog 1200:**

"The Dyna-Fog 1200 Series 2 Fog generator employs the concept of the automatic fuel oil heater to generate hot gases flowing at high velocity. The heated high velocity gases vaporize the formulation and discharge into the atmosphere where it is condensed rapidly causing negligible formulation breakdown. **This machine is intended for outdoor use only. Use of this machine in any confined space may create hazardous conditions leading to a fire or explosion."**

Fogging Formulations. *All thermal fogging formulations are combustible; that is, they all can be caused to burn. This is true even of high flash point or "no" flash point formulations. A combustible liquid vapor can be ignited because it readily forms a uniform mixture with the air which contains the oxygen needed for combustion. However, fine particle of combustible liquids or solids suspended in the air are capable of propagating flame one to another once ignition starts.*

A good analogy is the grain mill explosion. Although the fine particle dust in a grain mill has "no" flash point, the phenomena of the grain mill explosion is an all too common occurrence. While a high flash point or a "no" flash point formulation will ignite far less readily than a low flash point liquid, and for this reason is strongly advocated, the high or "no" flash point formulation can ignite if the proper conditions exist. These conditions are basically two:

1) A sufficient volume of liquid in the form of fine particles suspended in the air.

2) A sufficiently high energy source of ignition.

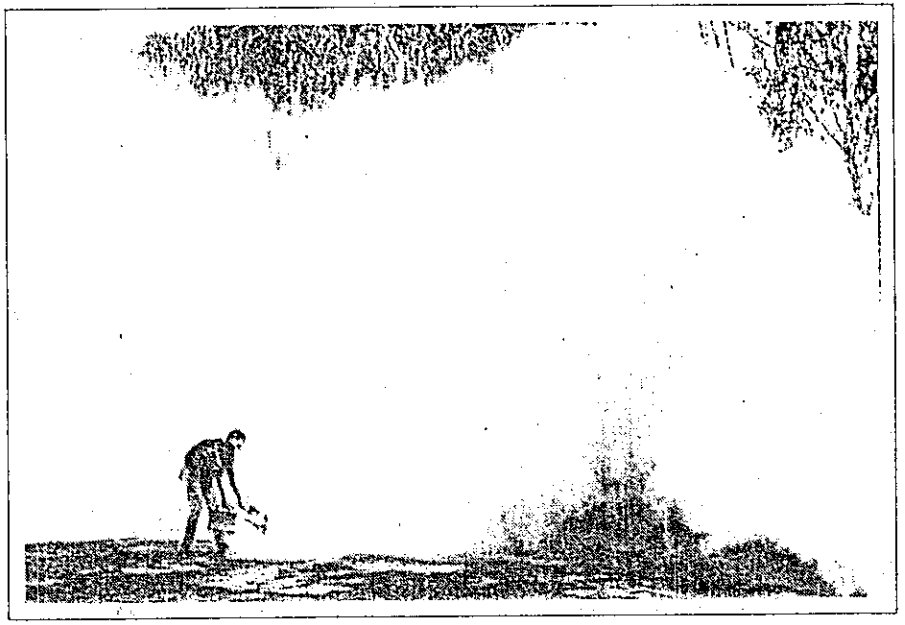
Do not use any formulations with a base more flammable than kerosene, Diesel fuel or No.2 fuel oil.

USE OF FORMULATIONS WITH A BASE OF ALCOHOL, BENZENE OR GASOLINE WILL CREATE HAZARDOUS CONDITIONS LEADING IMMEDIATELY TO A FIRE OR EXPLOSION.

EXCEEDING A CONCENTRATION OF 1 GALLON PER 50,000 CUBIC FEET (3.8 LITERS PER 1400 CUBIC METERS) CAN CREATE HAZARDOUS CONDITIONS LEADING TO A FIRE OR EXPLOSION.

* * * * * * * * * * * * *

SMOKE CANISTERS AND COMPOSITIONS:



Throughout this report I have concentrated mostly on smoke fluids and Smoke Machines. This is because they are the most common producers of smoke, to which film crews will be exposed to. In this chapter we look at smoke canisters and smoke compositions.

SMOKE COMPOSITIONS:

Smoke was used extensively in World Wars One and Two for both screening and signalling purposes. Many of the formulas used for creating these smokes were irritating and toxic.

Today smoke compositions come in many different forms and sizes, they are used in distress products for the marine industry, fireworks applications, pesticides and military training and operational activities.

The smoke products and compositions we use here in Australia for Special Effects usually fall into one of these categories. In America there a few companies who supply special smoke products for use in the Film Industry.

Smoke is generated from chemical smoke compositions by one of the following processes:

1) The burning composition creates a vapour which absorbs moisture from the air, usually producing white smoke.

2) The material is vapourized by the heat of combustion, then condenses again to form fine solid particles which create smoke.

3) Smoke is created through imperfect combustion of the

composition, generating tiny particles of carbon. As is the case in creating Black smoke.

4) Coloured smokes are produced by vapourizing a dye through combustion. The dye condenses into fine solid particles which appear as coloured smoke. Large amounts of dye need to be used in order to produce visible coloration of the smoke cloud. Simple coloured smoke compositions consist of 60% dye, 20% Oxidizer and 20% fuel.

One of the principle ingredients used by the Germans in World War Two for producing smoke was Hexachloroethane, $C_2 Cl_6$

Hexachloroethane, more commonly referred to as HC was mixed with zinc of various forms to produce white to grey-white smoke.

HAZARDS:
HC smokes produce gases of zinc chloride which form hydrochloric acid and zinc hydroxide on contact with moisture in the air.

HC (Hexachloroethane) Smoke Canisters have been employed on film sets for exterior battlescenes and the like, but are rarely used these days. One product, an HC spotting and screening smoke originally used by the Army in World War Two and shot out of three inch mortars, produced voluminous clouds of dirty grey-white smoke.

These canisters were sold for Effects use without tailfins and squibbed for electrical firing. They should only be expended

outside and inhalation of the smoke produced by them should be avoided.

BLACK SMOKE:

Usually created through the combustion of Black Smoke Pyrotechnic compositions, or the burning of vehicle tyres.

Black smoke comps. consist of carbon rich compounds mixed and burnt with an oxidiser. Large numbers of carbon particles are produced due to incomplete burning of the mixture.

The main carbon rich chemicals used are anthracene and napthalene. Anthracene $C_{14}H_{10}$ is produced through the distillation of coal tar. Napthalene $C_{10}H_8$ is also produced from coal tar and will be known to many of you as the smelly white flakes used to stop moths from eating your clothes.

Most Black Smoke comps. are not suitable for interior use. Inhalation should be avoided, and respirators with organic filters employed. Large particles of carbon will float in the air for long periods.

Non-toxic Black Smokes are possible but I have yet to see one. Discussions with Australian Defence Industries suggest that they could create a smoke canister that is non-toxic and uses a dye to create black smoke instead of through incomplete combustion of carbon rich materials. However, most Black organic dyes that could be used, are actually a very dark blue colour and this may be a limiting factor in creating a dense black smoke via means of a dye.

COLOURED SMOKES:

Coloured smoke compositions consist of dyes, a small amount of oxidiser and some kind of carbohydrate, usually lactose (milk sugar) or sucrose(cane sugar), which lowers the burning temperature. The composition is either pressed into pellets or directly into a casing. The heat generated by the oxidizer and the lactose or sucrose is enough to vapourize the dye and form tiny coloured particles in the atmosphere.

Further ahead I have mentioned specific companies and sources of coloured smoke compositions.

SMOKE POTS:

The term Smoke Pot is a general one to describe pressed smoke comp. or pellets in a cylindrical cardboard or metal container.

Smoke Pots can be lit via a fuse, electrically ignited or be set off via a strike-sensitive igniter similar to matches. They can generate very large quantities of smoke and are most often used on exterior scenes areas which would be difficult to cover using smoke machines. Smoke emission times vary as do size and colour.

Smoke Pots and cannisters generate a lot of heat and can easily set fire to any combustible material around them. Water extinguishers or sand are the best methods of extinguishing them.

SMAREX SMOKE GRENADES AND CANISTERS:

St Marys M.F.F (Munitions Filling Factory) was established at St Marys between Sydney and the Blue Mountains in 1957. Recently privatised, St Marys now operates under the banner of Australian Defence Industries.

One of the products produced by A.D.I suitable for use in the Film Industry is their range of SMAREX Coloured Smoke Grenades. The smoke is non-toxic and is available in a variety of colours red, blue, green, yellow-orange, yellow, orange and white. the smoke emission time of the cannisters can vary from 15 to over 100 seconds.

SMAREX Smoke grenades are primarily intended for military use, however, for "Crocodile Dundee II" St Marys especially produced an Off-white Smoke Canister to simulate bush fire smoke. Australian Defence Industries are interested in supplying the Film Industry, and where economically practicable will look at special orders.

The composition of SMAREX smokes is very similar to the description I gave for coloured smokes on page 49. The organic dyes used are a pyrotechnic grade and are regarded as a very low hazard to health.

NICO SMOKE:

Nico PII Smoke Pellets and NT Smoke Blocks are produced by Nico Pyrotecknik of Germany and distributed in Australia by Kenmax Special Products Pty Ltd.

Nico Smokes are primarily designed for military and civil authority use, and have been designed to replace HC smokes. They are also frequently used in the testing of air-conditioning.

The unique thing about the Nico products is that they are free of any outside container or casing. Small chips can be cut off the blocks, and these chips are often used by Special Effects men for special smoke situations, like creating cooking smoke or radiator steam. Nico smoke is an excellent product for Special Effects applications.

The Nico NT blocks come in 100, 200gm, 500gm, 1 kilo and 10 kilo sizes. They all generate enormous amounts of white smoke. The smoke has a slight burnt caramel odour to it, and is considered to be of very low-toxicity. Small amounts of Nico smokes can be used inside but care should be taken not to create excessive amounts of smoke in enclosed spaces.

Nico PII Pellets come as four x 7 gram pellets to a packing tube and generate resonably large quantities of white smoke. Each pellet burns over a 20-25 second period. The pellets are a convienient way to quickly create white smoke. Ken McBroome from Kenmax Special Products refers to the pellets

as Son of NT. Chemically the pellets are only slightly different from the NT blocks, and are even less irritating to inhale in concentration.

The following is an excerpt from a Nico information sheet on the NT screening smoke :

Technical data:
The solid is zinc oxide and ammonium salt based, is chemically neutral and has virtually unlimited storage life. Combustion is at ca. 800-850 degrees celsius, and is flameless. Burning continues even under water spray conditions. Rate of combustion depends on free surface area. e.g.10 kilo block in 1 minute or 5 minutes. Ignition by pyrotechnic inserts, electrical fuse, storm match, cigarette, match, percussion fuse. Smoke pH value 5.6 - 6.2 dense pure white, only toxic in extremely high concentration, particle size 0.7 - 0.9 microns Ash: is ca. 1% by volume of solid and is non abrasive, non toxic — mostly carbon.

SPECTRASMOKE

Los Angeles based Tri-Ess Sciences Inc. produce a wide range of white and coloured smoke products called Spectrasmokes.

They are normally used inside for film and stage effects. Spectrasmoke is available in powder, granular and solid form as smoke "cookies". The cookies are ignited by lighting with a match and then blowing out the flame. They can be burnt whole, or in small chunks on a metal plate and wafted around

the room. Burning temperature is around 170 degrees F.

Spectrasmoke products can produce the following colours; white, red, yellow, green, blue, violet, grey, off-white, orange and pink.

Personally, I feel the colours are not that bright and happy but a little dull looking. Different smoke cookies can be ignited together to produce different shadings and effects which is very useful.

The Spectrasmoke range has been extensively tested in the U.S. and is considered non-toxic. Spectrasmoke products have been used on numerous films and television shows in the U.S. and are considered by some to be the industry standard.

HAZARDS:

Tri-Ess are secretive about the actual ingredients used in their Spectrasmoke products, and since they contain no hazardous materials they are not required to supply a M.S.D.S. Suffice it to say that they would work along similar lines to other coloured smokes. Consisting of an organic dye, oxidiser and a low burning temperature fuel.

The following is an excerpt from the Tri-Ess Special Effects Catalog on Spectrasmoke :

In October 1986 at the request of NABET (National Association of Broadcast Employees and Technicians) the Center for Disease Control of the National Institute for Occupational Safety and Health evaluated a group of fogging

compounds. Included in this test was Spectrasmoke (powders and solids) fogging materials. "No health effects from exposure to the airborne components could be expected . The acid levels were all below 7mg/M^3 which is the standard adopted by OSHA. This level is sufficiently low to prevent any toxic injury, but improper use could cause respiratory irritation. It is possible that operators may be exceeding this level which can cause greater irritation." The Institute felt that simple precautions for use and exposure are sometimes ignored by personnel.

None of the materials used in the composition present any known health or safety hazards. However, the resultant smoke can be irritating to some people. People with respiratory problems, allergies or pregnant women should avoid any extended exposure to Spectrasmoke or any other fogging materials.

ROGER GEORGE COLOURED SMOKE PATTIES:

Roger George Inc. also produces a range of coloured smokes. Due to higher amounts of dye than Tri-Ess's Spectrasmokes, Roger's coloured smokes are definitely brighter and more vibrant to the eye.

LIQUID CO2:

Food grade liquid Co2 in bottled form is often used to create the effect of ruptured steam lines and the like. Though it is not a smoke effect as such, it does provoke questions from some crew members. It is essentially harmless, although care must

be taken not to allow small chunks of Dry Ice "snow" to land on the skin, as it is extremely cold and can cause localized burns.

LIQUID NITROGEN:

Liquid Nitrogen is used infrequently on Australian movie sets but it is worth mentioning briefly. Liquid nitrogen can be used to generate a fog effect similar to Dry Ice Fog. Extreme care is required when using liquid Nitrogen .

A/B SMOKE:

A/B(Acid & Base) smoke is a chemical smoke which is produced when two different liquid chemicals interact, (usually Cyclohexylamine and Ascetic acid). Component A or B can be sprayed onto a surface then the other can be misted on from above creating the effect of smoke appearing from nowhere.

This smoke is Toxic, the liquid is highly acidic and will burn the skin. Vaseline or barrier cremes can help protect the skin. The fumes will attack the respiratory system, the nasal passages and affect the eyes. It is imperative to ensure adequate ventilation and protection. A/B smoke is excellent for creating special smoke effects, so long as it is given proper handling and consideration.

Respirator masks with organic filters should be used as protection against the fumes of A/B smoke

FUTURE DEVELOPMENTS

UNIFOGGER:

Produced through the University of Sydney, this unit uses Ultrasonics to produce a water fog. Nicknamed the cold coffee perculator the unit generates high frequency ocillations which shatter water molecules and allow them to form an aerosol.

Cameron McClean, a Technical Officer at the University of Sydney, has built a small unit which will completely fog out a cool room 3 metres square. The unit costs $600 to produce and requires a mere 45 watts of power to run. Cameron has had difficulty finding circuit protection small enough! He has built over 300 of these units, their purpose is to create dew on the leaves of plants for research into fungicdes at the school of agriculture in Castle Hill.

Further development of this system could undoubtedly lead to a very safe and quiet means of smoke production for interior use on film sets.

EQUIPMENT & MATERIALS:

The equipment and smoke products mentioned in this report are available from the following suppliers to the Film Industry. This is not intended to be a complete list of suppliers in Australia, but most of the smoke products covered in this report are available from one or more of the companies listed below.

SPECIAL EFFECTS EQUIPMENT AND SERVICES:
Portafog Smoke Machines
Mega Fogger
Small Mee Fog system
IGEBA Swingfog Machine (with coloured smoke)
JA JA Foggers
Cracker Fogger
Type 3000 Water based(Safe)
and oil based Smoke Fluids for sale
Hire and Sales of Smoke Machines and Products
CONTACT: Neville Maxwell
PHONE:(02) 450-2956
FAX: (02) 450-2956

KENMAX SPECIAL PRODUCTS:
Importers and Distributors of
Nico Ph Smoke pellets and
100, 200, and 500 gram NT smoke blocks
CONTACT: Ken Mcbroome
PHONE: (02) 872-5335
FAX: (02) 872-5657

PRIDE EFFECTS:
Cracker Fog System with
2x Venturis for breaking up smoke
Requires large Air Compressor
CONTACT: Tad Pride
PHONE: (02) 807-3099

CINEFFECTS
4x Gas operated London Foggers
Mini-Big Smoke
Available for hire
CONTACT: Tom Davies
PHONE: (02) 361-3122

HOWARD AND SONS PYROTECHNICS:
CONTACT: Don Wilson or Les Howard
PHONE: (02) 627-1694
A variety of Stage and Outdoor Smoke pots,
and Smoke composistions.
Pyrotechnic Liscenses required for loose Smoke comps.

Smoke pots are available in Red, blue, green, white, orange, and yellow. Can be set off electrically or hand lit. 15 second burn time in aluminium cans or 60 second burn time in Cardboard tubes with metal base and top. The composition is the same as used in SMAREX smoke grenades.

Howards also stock Nico NT smoke blocks in the 200 and 500 gram sizes, as well as the PH smoke pellets.

COMBAT SIMULATION SYSTEMS (AUST.) PTY LTD.
15 second Orange Smoke pots, Nico PH pellets and NT smokes. Special orders accepted, can provide coloured smokes with a variety of burn times. Using SMAREX pellets in own casings.
CONTACT: Rod Morris
PHONE: 872-5657
FAX: 872-5657

ROGER GEORGE, INC
Special Effects Rentals
14525 1/2 Bessemer St.
Van Nuys, California 91411.

Roger is probably the largest supplier of Special Effects Equipment in the United States. He is the main agent and distributor for the Mee Fog system, which produces a safe fog effect from water. Roger has Mee Foggers available for both sale and hire. The system has been used extensively over recent years in the United States. It certainly is an exciting system and one that will find many applications in Australia.

Roger also has a range of vibrant Coloured smoke powders and cookies.

Both Madewell Smoke machines and Igeba TF-30s are available through Roger George also.

TRI-ESS SCIENCES INC:
1020 W.Chestnut St.
Burbank, CA 91506

Tri-Ess is a Los Angeles based company which initially supplied chemical products for Universities and U.S. Special Effects men. As demand increased they developed a wider range of products for Make-up and Special Effects men.

They now produce a specialty range of non-toxic coloured smoke products for film and television use known as SPECTRASMOKE which is available as:

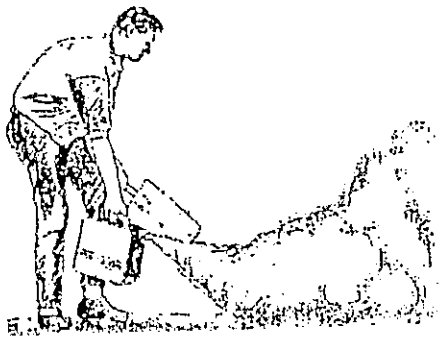
Smoke Powder,

Smoke Pots,

Smoke Cookies, (a solid disc which can be broken into chips)

30 cm Smoke stacks,

in Cartridge form, and as Smoke grenades.



JUST WHAT IS SAFE ?

Many times in the preparation of this report I have concluded that it all comes down to exposure.
No exposure — No risk !

Excessively high levels of any fog or smoke media will be irritating and potentially hazardous to those who are exposed to it for long periods.

However, proper use and application of Special Effects Smoke materials is unlikely to produce any detrimental health effects to those persons exposed to them.

I would recommend wherever possible:

Productions should employ responsible, experienced operators who are familiar with the products and equipment they are dealing with.

Persons should avoid inhalation of chemical smokes like Titanium Tetrachloride, A/B smokes, Black smokes or HC (Hexachloroethane smokes) without some form of respiratory protection. Eg. Respirators with organic vapour cartridges, not dust particle masks.

Sensitive individuals or those with breathing difficulties such as asthma should remove themselves from smoke filled sets if they feel adversely affected.

ABOUT THE AUTHOR: Alan Maxwell has been working in the field of Special Effects since 1980 on some 16 Feature films and over 25 Television mini-series and shows. He has had extensive experience with smoke equipment and products.

In January 1989 he received a Travel Grant from the Australian Film Commission to visit Los Angeles and research new smoke products currently being utilized in the Film Industry there.

SPECIAL THANKS TO:
Roger George for providing information and demonstrating the Mee Water Fog system.

Thaine Morris at BOSS FILMS for allowing me to observe the Mee Water Fogger during filming.

Kimberly Greenfield at Tri-Ess Sciences for providing Data on the Right-to-know laws and contact with Los Angeles Effects men.

* *

This report was produced on an Atari 1040ST Computer using Pagestream and output to a Qume Laser Printer.

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REFERENCE SECTION

This section contains material safety data sheets and other specific information on smoke fluids and solids

October 20,1986
HE 85-253

CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR
OCCUPATIONAL SAFETY & HEALTH
ROBERTA.TAFT LABORATORIES
4876 COLUMBIA PARKWAY
CINCINNATI,OH45226

Ms. Liz Argo-Clark
National Association of Broadcast
Employees and Technicians
20 Aqueduct Avenue
Midland Park. New Jersey 07432

Dear Ms.Argo-Clark:
In March 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from representatives of the National Association of Broadcast Employees and Technicians (NABET).Local 15,to evaluate employee exposures to artificial fogging compounds which are used to generate "fog" or ''smoke'' during the filming of television commercials and rock videos.

NIOSH had some background information on a few artificial fogging compounds from previous surveys. In addition, to address the concerns expressed in the request. NIOSH collected information from the manufacturers of the compoundsas well as conducting analyses to determine the composition of the fogging compounds and the ''fogs'' they generated under laboratory conditions. This information was compiled such that appropriate sampling media could be assembled to measure the chemical composition of the airborne contaminants

produced during the actual use of the substances.

Establishing a sampling and analytical strategy was complex, based on the number of fogging compounds available and their varied composition. Based on the information which was gathered during the planning phase of this project,a decision was made to sample for three groups of contaminants.

A charcoal tube would be used for the collection of organic compounds. An impinger containing distilled water would be used for the determination of acid mists and cellulose ester filters would be used to determine the concentrations of minerals and metals.

NIOSH first attempted to collect airborne samples of the contaminants generated by the use of the fogging compounds during actual filming situations. Due to noise from the sampling pumps and breakdowns of studio equipment,the samples collected were judged unrepresentative.

An attempt was then made to collect air samples under simulated conditions with a 12 to 15 foot ceiling. The studio was equipped with a large exhaust fan to evacuate the fog after each simulation. In general,the studio was fogged to simulate conditions which union representatives said approximated conditions during a ''snoot''. Attempts were made to collect samples over a two to three hour period.

Most of the fogs settled or dispersed before that period, and additional fog was generated, as would be the case during an çactual filming. After each simulation. the exhaust fan was operated for one-half hour to one hour to evacuate the air of the product used for the simulation.

During the time period of two days (May 29-30, 1986), seven different fogging compounds were tested. Three of

the fogging compounds,Rosco Fog,Mushroom Fog and Optimist were liquids.The other four fogging compounds,Olibanum Gum; Times Square Smoke Powder,Tri-Ess Smoke Cookie; Spectrasmoke Blue and Tri-Ess Smoke Cookie, Spectrasmoke Red were solids.

A total of 13 filter samples, 32 charcoal tube samples and 19 impinger samples were collected during the simulations using the seven fogging agents. The filters were each analyzed for 28 elemental minerals, the impingers were analyzed for 5 acids and the charcoal tubes were analyzed for 14 organic compounds which were identified to be present based on gas chromatography/mass spectrometry analyses of a representative number of samples from the set.

A review of the sampling results snows what appears to be cross-contamination of samples as a result of testing several fogging compounds in the same location over a short time period and also contamination of the organic vapor samples as a result of a floor stripping operation occurring in an adjacent studio during the time of the testing. However, we believe some interesting differences in potential exposures based on the type of fogging compound used can be identified.

If the liquid fogging agents tested are considered representative of the liquid products available, certain general statements can be made. It is believed that the floor stripping material used in the studio adjacent to the tests contributed significantly to the number and quantity of volatile organic compounds identified on the charcoal tube samples.As a result, no individual organic compounds measured will be identified or quantified, as such information may not accurately reflect fogging compound products. However, it is important to note that the fourteen compounds identified and quantified, all were of low toxicity and all concentrations of volatile organic compounds

measured.even with the unknown contribution of the floor stripper, were less than 1.4 ppm. These concentrations are below levels believed to cause any adverse health effects. Hydrochloric acid levels measured during the testing of two of the liquid agents showed concentrations of up to 0.8 mg/M^3.

It is believed these levels are a result of residual levels of acids from testing the solid materials, as previous analyses of the liquid agents gave no indication of components which would release hydrochloric acid. In conclusion, no hazardous compounds or levels of contaminants were identified in association with the liquid compounds.

In reviewing the data for the solid fogging agents, certain general statements can also be made. The Olibanum Gum is a natural product and should be considered separately from the other solid materials tested. Only low level exposure to organic materials, especially terpenes was measured.

No health effects from exposure to its airborne components would be expected. The other solid compounds tested appear to have similar characteristics and are similar in release of airborne contaminants to other solid smoke generating devices previously evaluated by NIOSH. Only low level exposures to volatile organic materials were measured.

The most significant exposure as a result of the use of these materials appears to be exposure to acids, in particular hydrochloric acid (HCl). During testing of the solid materials all samples showed positive levels of HCl with concentrations ranging from 0.21 mg/MÉ3Ç up to 4.8 mg/MÉ3Ç. The OSHA standard and ACGIH TLV for HCl is 7 mg/MÉ3Ç. This ceiling limit for HCl is interpreted to be sufficiently low to prevent toxic injury. but on the borderline of severe irritation. Exposure to HCl at the

levels measured during the simulation would easily account for the irritant symptoms being reported by employees. It is also very likely that the 7 mg/M^3 level is exceeded at times during the use of these compounds resulting in the possibility of health effects beyond those of irritation.

Therefore, based on the information collected during the simulated use of fogging compounds we would draw the following conclusions:

1. In general, the use of liquid fogging compounds in confined areas appears to pose less of a health hazard than the use of solid fogging agents. This statement is based on the composition of the fogging compounds and the measured contaminants released during their use.This,however,assumes the specified fogging machine is used and the thermal settings are correct so the fogging agents do not undergo thermal decomposition.Hazards associated with overheating of liquid compounds were not evaluated.

2. The use of the majority of solid fogging compounds will result in exposure to hydrochloric acid. The degree of exposure will be related to the compound used and its extent of use. Further evaluation under the conditions of use are needed to determine more accurately the concentrations generated and their potential for serious or long term effects.

It is reasonable at this point that all warning labels on these materials should be followed.Some of the solid fogging compounds carry warning labels indicating that they are not to be used indoors. It is reported that such warnings are frequently ignored. It is imperative, for safety reasons,that all warnings be followed.

Based on new sampling equipment now available. we feel the noise associated with sampling can be reduced to a

level which will allow sampling during filming. Such sampling is essential to determine the extent of exposure,its potential health implications and appropriate safety measures to be followed.

A NIOSH industrial hygienist will be contacting you in the near future to pursue the possibility of conducting additional sampling. If you have any questions concerning this information. Please feel free to contact me at 513-841-4374.

Sincerely yours,
Dawn Tharr
Chief
Industrial Hygiene Section
Hazard Evaluations and Technical
Assistance Branch
Division of Surveillance, Hazard
Evaluations and Field Studies

cc:David Turetsky. NABET

Shell Oils

PDS No. 5705
Jan 1988

ONDINA OILS

MEDICINAL QUALITY WHITE OILS AVAILABLE IN ISO VISCOSITY GRADES, 15, 32 AND 68.

DESCRIPTION

Shell Ondina Oils are water white oils which meet the purity requirements of the British Pharmacopoeia and U.S. Food & Drug Administration Regulation 172.878.

Shell Ondina Oils find application in the foodstuff, pharmaceutical, cosmetic and veterinary industries where lubricant contact with foodstuff, medicinal or skin care products is likely.

SUMMARY OF BENEFITS

As Shell Ondina Oils meet the highest Pharmacopoeia standards, they are safe to use in food processing and pharmaceutical industries. They are almost tasteless and odourless and do not fluoresce in daylight.

PERFORMANCE FEATURES

Suppliers and users must take every precaution to ensure that there is no possibility of Shell Ondina contamination by products which could destroy the necessary purity and quality.

HEALTH AND SAFETY

Shell Ondina Oils are most unlikely to pose any toxic hazard in normal use in the recommended applications. However, it is always advisable to observe good standards of cleanliness and personal hygiene and particularly avoid prolonged skin contact with any oils. Full Safety Data information for all Shell products is available on request.

TYPICAL CHARACTERISTICS

	Density @ 15°C kg/L	Flash Point, Open °C	Pour Point °C	Visc. @ 40°C cSt	Visc. @ 100°C cSt	Visc. Index
Shell Ondina Oil 15	0.844	180	-9	15	3.4	98
32	0.854	200	-9	32	5.3	98
68	0.863	230	-6	68	7.3	99

HEALTH HAZARD INFORMATION

HEALTH EFFECTS
SWALLOWED
Non-toxic
EYE
Non-irritant
SKIN
Non-irritant
INHALED
Not applicable
FIRST AID
SWALLOWED
If swallowed, do NOT induce vomiting. Give a glass of water.
SKIN
Wash with soap and water
INHALED
Not applicable

ADVICE TO DOCTOR
Non-toxic medicinal grade oil.Treat symptomatically.

PRECAUTIONS FOR USE

EXPOSURE LIMITS
5 mg/m^3 TWA
VENTILATION
No special ventilation required
PERSONAL PROTECTION
Not required
FLAMMABILITY
Not a fire hazard

SAFE HANDLING INFORMATION

STORAGE AND TRANSPORT
No special requirements
SPILLS AND DISPOSALS
Collect for disposal. Dispose of according to local requirements

FIRE/EXPLOSION HAZARD

Not combustible

OTHER INFORMATION

Meets B.S.P."liquid paraffin" and U.S.P."mineral oil"

Contact Point: SHELL

Date: 24/7/88

Mobil Oil Australia Limited

MATERIAL SAFETY DATA BULLETIN

PRODUCT:

WHITEREX 108, 307, 330, 331D

USE: Medicinal quality paraffin oils for cosmetic, pharmaceutical and/or industrial use.

INGREDIENTS: Highly refined white paraffin oils

PHYSICAL DATA: APPEARANCE: Water white liquids

	Grade 108	307	330	331D
Density @ 15°C	0.84	0.84	0.87	0.87
Pour Point °C	-18	-18	-15	0
Flash Point °C	170	170	230	230
Viscosity cSt @ 40°C	13	13	58	68
Boiling Point °C	>300	>300	>300	>300
Vapour Pressure mm Hg @ 20°C	<0.1	<0.1	<0.1	<0.1

FIRE & EXPLOSION HAZARD DATA: Flash point over 170°C. Will not burn unless heated to high temperatures. Extinguish fires with CO_2, Dry Chemical, Foam or BCF. Fire fighters should wear self-contained breathing apparatus if fire is in poorly ventilated area and is too large for hand-held extinguishers.

HEALTH HAZARD DATA:

ACUTE TOXICITY CLASSIFICATIONS				
TOXICITY			IRRITATION	
ORAL	DERMAL	INHAL	EYE	SKIN
0	0	0	0	0

DEFINITIONS		
NON-TOXIC	(0)	NO EFFECT
SLIGHTLY TOXIC	(1)	SLIGHT IRRITANT
MOD. TOXIC	(2)	MODERATE IRRITANT
TOXIC	(3)	STRONG IRRITANT
HIGHLY TOXIC	(4)	SEVERELY IRRITANT
UNKNOWN	(5)	

Effect of over-exposure: Not expected to be a problem.

EMERGENCY & FIRST AID PROCEDURES:

EYE CONTACT: Flush with water.

SKIN CONTACT: Wash exposed areas with soap and water.

INHALATION: Remove from further exposure. If discomfort persists, seek medical assistance.

INGESTION: Not expected to be a problem. If uncomfortable, seek medical assistance.

REACTIVITY DATA: INCOMPATIBILITIES: Strong oxidisers.
Hazardous decomposition product: Carbon Monoxide
Product is considered stable.

SPILL OR LEAK PROCEDURE: Absorb on fire retardant sawdust, diatomaceous earth or other absorbent. Dispose as normal refuse. Waste management: Dissolve waste in a flammable solvent* and dispose by supervised incineration in compliance with local regulations. (*Recommended flammable solvent - Diesel Oil, Kerosene or Heating Oil).

STORAGE & HANDLING PROCEDURE: PROTECTION: No special requirements.

ISSUE DATE: October 1983
(756791) (Supersedes Jan. 1983 issue
(757112) entitled "Whiterex 330")
(757286)
(7572941)

FOR INFORMATION
INDUSTRIAL HYGIENE: N.H. Tresider
TECHNICAL SERVICE: P.L. Rogers
MEDICAL: P.D. Clark

Roger George, Inc

SPECIAL EFFECTS
14611 Bessemer St., Van Nuys, CA 91411

FOG FLUID INFORMATIONAL DATA SHEET

Product Name: Fog Fluid
Manufacturer: MP Associates, Inc.
484 Lake Park Ave,
Oakland, Ca. 94610
(415) 465-0782

Specifications: Consists primarily of water, glycerols and scents.
Shipping Restrictions: None; non-hazardous material.
Fog fluid is designed to produce dense white smoke for atmospheric effects in the entertainment industry.
To alleviate any apprehension about the use of our materials, the basic ingredient presents no hazard when being used. However, some people do have lower tolerances to various smokes than others, and could experience minor throat or eye irritation over an extended period of time of exposure.
We recommend that our product be used in a well-ventilated area. Any persons with respiratory problems should not be directly exposed. It is our recommendation that any persons using our material exercise precautions necessary to insure adequate ventilation.
None of the chemicals used in the manufacturing of Fog Fluid products appear on the Directors List of Hazardous Substances and therefore a Material Safety Data Sheet is not required.
The information accumulated herein is believed to be accurate, but is not warranted to be, whether originated with MP Associates, Inc.or not.

EXTRACTS FROM ICI PRODUCT BULLETIN

ALTERNATE NAMES:
Triglycol, glycol bis(hydroxyethyl) ether, ethylene glycol bis(2-hydroxyethyl) ether.

DESCRIPTION:
Triethylene glycol (T.E.G.) is a colourless hygroscopic liquid. It is readily soluble in water and alcohol and is partially soluble in ethyl ether. Its properties closely resemble those of diethylene glycol and its end uses largely overlap. Triethylene glycol has a higher boiling point and is used in preference to D.E.G. where volatility in a compound is a factor.

PHYSICAL PROPERTIES OF PURE TRIETHYLENE GLYCOL:

Boiling point at 760mm	287.4°C
50mm	198°C
10mm	162°C
Flash point (closed cup)	310°C
Freezing point	-7.2°C
Heat of combustion at 20°C	-850kcal/mol
Heat of vapourization at 760mm	179kcal/mol
Spontaneous ignition temperature	206°C
Surface tension at 20°C	45.2dynes/cm
Vapour pressure, 20°C (68°F)	0.01mm Hg.
101°C (213°F)	0.4mm Hg.
159°C (318°F)	10 mm Hg.
202°C (395.6°F)	60 mm Hg.

CHEMICAL PROPERTIES:
Triethylene glycol behaves as an ether and as a dihydric alcohol, and by virtue of its two hydroxyl groups it can form mono- and di- ether or ester derivatives. In many of its applications triethylene glycol is an alternative to other glycols, particularly diethylene glycol, which it closely resembles. It can also be regarded as an economic replacement for glycerol, in which role it has the advantages over ethylene and diethylene glycols of higher boiling point and lower toxicity.

COMMERCIAL APPLICATIONS:
The physical properties on which the usefulness of triethylene glycol principally depends are its hygroscopicity. its high boiling point, its solvency for a

wide range of substances, and its miscibility with water and many organic solvents. In some applications it may be technically more suitable than glycerol because of its lower viscosity.

Cork Compositions: Di- and tri- ethylene glycols are often incorporated in compositions of granulated cork as plasticisers: as humectants they prevent desiccation. The lower volatility of triethylene glycol is an advantage here, giving greater plasticiser permanence than diethylene glycol. There may also be some argument in its favour on the grounds of toxicity where the product is used in contact with foodstuffs, for example in bottle cap liners.

Cellulose Film: The most widely used plasticiser for cellophane is glycerol: this acts as a humectant, stabilising the moisture content of the film. In this application various glycols are suitable cost-reducing partial replacements for glycerol and may improve certain properties of the film; they can, for example, enhance the low-temperature performance of cellophane used in deep-freeze storage. Ethylene and diethylene glycols have long predominated in this role, but recently, on toxicity grounds, their use in foodwrapping film has been banned by the U.S. Food and Drug Administration; this lead may well be followed in other countries. As a result interest has shifted to other glycols, principally propylene and triethylene glycols. Triethylene glycol, approved by the F.D.A. in the United States provided its diglycol content is below 0.1%, has a lower volatility than that of propylene glycol, and this means lower loss by evaporation during and after processing.

Extraction of Aromatics: Triethylene glycol is normally used in Udex units for the extraction of aromatics from paraffin mixtures; it has greater capacity and selectivity than other glycols.

Air Disinfection: A good deal of research has been done on the effect of triethylene glycol on air-borne bacteria and viruses. This has shown that that triethylene glycol is a useful and and safe air steriliser; it should, therefore, be of value in air freshness formulations, including those for aerosol.

STORAGE, HANDLING AND SAFETY:
Triethylene glycol can be stored and transported in mild steel vessels at ambient temperatures without causing corrosion, and, because of its high flash point of about 310°F (155°C), there is little risk of fire. It is considered non-flammable for the purpose of conditions covering the transport and storage of goods.
Triethylene glycol is poisonous if swallowed in large quantities and is an irritant to the skin and eyes.
If swallowed - apply artificial respiration if breathing has ceased. If conscious, encourage vomiting by giving two tablespoons of salt in 1/2 tumbler of water. Seek medical attention.
If inhaled - In high vapour concentrations headache, nausea and vomiting, dizziness and shortness of breath may occur. Removal to fresh air will reverse these effects.
If liquid enters the eyes - Wash out well with water for 5 minutes.
If any symptoms persist - Seek medical attention.

It is recommended that personnel handling this material should wear protective clothing including rubber gloves, overalls and chemical goggles.

MATERIAL SAFETY DATE SHEET
DOW CHEMICAL (AUSTRALIA) LIMITED

PRODUCT NAME: PROPYLENE GLYCOL USP PRODUCT CODE: 70531
EFFECTIVE DATE: 10 NOVEMBER, 1986 DOC NO: 80

1.INGREDIENTS:
PROPYLENE GLYCOL (CAS NO. 57-55-6)

2.PHYSICAL DATA:
BOILING POINT:188^{O}C
VAPOUR PRESSURE:0.22 mmHg @ 20^{O}C
VAPOUR DENSITY (Air=1)2.62
SOLUBILITY IN WATER:Complete
SPECIFIC GRAVITY:1.038 @ 20/20^{O}C
APPEARANCE:Colourless liquid
ODOUR:Odourless

3.FIRE AND EXPLOSION HAZARD DATA:
FLASH POINT: 103^{O}Method used: pmcc
FLAMMABLE LIMITS (STP in Air):
LFL: 2.6%UFL: 12.5%
EXTINGUISHING MEDIA: Water fog, alcohol foam, carbon dioxide, dry chemicals.
FIRE AND EXPLOSION HAZARDS: Not available.
FIRE-FIGHTING EQUIPMENT: Wear positive-pressure, self-contained breathing apparatus.

4.TRANSPORTATION INFORMATION:
This product is not included in the Australian Dangerous Goods Code either by reference to a specific substance name or a generic substance name or group.

5.REACTIVITY DATA:
STABILITY: (Conditions to avoid) Stable under normal storage conditions.
INCOMPATIBILITY: (Specific materials to avoid) Oxidizing material.
HAZARDOUS DECOMPOSITION PRODUCTS: Propionaldehyde, carbon monoxide in the presence of limited oxygen in a fire situation.
HAZARDOUS POLYMERISATION: Will not occur.

6.ENVIRONMENTAL AND DISPOSAL INFORMATION:
ACTION TO TAKE FOR SPILLS/LEAK:
Small spills: Cover with absorbent material, soak up and sweep into a drum. Large spills: Dike around spill and pump into suitable containers.
DISPOSAL METHOD: Reprocess or burn in an approved incinerator in accordance with all federal, state and local requirements.

7. HEALTH HAZARD DATA:
EYE: May cause slight transient (temporary) eye irritation. Corneal injury is unlikely.
SKIN CONTACT: Prolonged contact is essentially non-irritating to skin. Repeated exposure may cause slight flaking, tenderness and softening of the skin.
SKIN ABSORPTION: A single prolonged exposure is not likely to result in the material being absorbed through the skin in harmful amounts. The LD50 for skin absorption in rabbits is greater than 10 g/kg.
INGESTION: Single dose oral toxicity is low. The oral LD50 for rats is 21-33.6 g/kg. No hazards anticipated from ingestion incidental to industrial exposure.
INHALATION: A single prolonged (hours) inhalation exposure is not likely to cause adverse effects. Mists are not likely to be hazardous.
SYSTEMIC AND OTHER EFFECTS: Repeated excessive ingestion may cause central nervous system effects. Did not cause cancer in long term animal studies. Birth defects are unlikely. Exposures having no adverse effects on the mother should have no effect on the foetus. In animal studies, has been shown not to interfere with reproduction. results of in vitro ("test tube") mutagenicity tests have been negative. results of mutagenicity tests in animals have been negative.

8. FIRST AID:
EYES: Irrigate immediately with water for at least 5 minutes.
SKIN: Wash off in flowing water or shower.
INGESTION: No adverse effects anticipated by this route of exposure.

INHALATION: No adverse effects anticipated by this route of exposure incidental to proper industrial handling.
NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgement of the doctor in response to reactions of the patient.

9. HANDLING PRECAUTIONS:
EXPOSURE GUIDELINE(S): Dow Industrial Hygiene Guide is 10 mg/m^3 mist, 400 ppm vapour.
VENTILATION: Good general ventilation should be sufficient.
RESPIRATORY PROTECTION: When airborne exposure guidelines and/or comfort levels may be exceeded, use an approved air-purifying respirator.
SKIN PROTECTION: Use impervious gloves when prolonged or frequently repeated contact could occur.
EYE PROTECTION: Use safety glasses. Where contact with liquids is likely, chemical goggles are recommended because eye contact with this material may cause pain, even though it is unlikely to cause injury.

10. ADDITIONAL INFORMATION:
SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:Exercise reasonable care and caution.
MSDS Status: Revision of existing MSDS (10/10/85), inclusion of new section - Transportation information, and re-numbering of all sections. NOTE: Introduction of new Emergency response Phone Number.

THE INFORMATION HEREIN PRESENTED IS GIVEN IN GOOD FAITH, BUT NO WARRANTY, EXPRESSED OR IMPLIED IS MADE. CONSULT DOW CHEMICALS (AUSTRALIA) LIMITED FOR FURTHER INFORMATION.