SMOKE WITHOUT FIRE – Mike Wood

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Note: Throughout this article the word ‘Smoke’ is used in its theatrical sense. It is important to realize that in actual fact modern ‘smoke’ machines produce a fog or mist consisting entirely of liquid droplets. Actual smoke is composed of solid particles and is not commonly used in theatrical effects except when using pyrotechnics.

The use of fog or mist in entertainment productions has become increasingly common in recent years. Film and Television, Theatre and Concert - fog is everywhere. From early dramatic use purely as a practical effect to simulate fires, battlefields or fog through its use in concerts and theatre to accentuate light beams we reach today's programs where almost any film or TV production can benefit from the atmospheric softenings and shadings creative fog use can give. From 'Home Improvement' to 'Mystery’s Poirot', everybody needs fog.

The Ancient Greeks used smoke from burning pitch or tar. The Chinese used gunpowder and pyrotechnics. Shakespeare used smoke to lend veracity to battle scenes. All these techniques produced ‘real’ smoke. It is fortunate that most theatres were outdoors so hopefully the audience and performers escaped what must have been choking sulfurous fumes.

Steam pipes in the Paris Opera House in the 1890's.

One hundred years ago steam was used in large theatres to "safely"(?) simulate smoke. The engraving above shows a system of steam pipes installed in the Paris Opera House in the early 1890 's. I leave it to your imagination to consider the problems jets of live steam would cause a Safety Officer today - although the gentleman in the center of the picture with the helmet and ax might be more familiar.

Later on chemical means were increasingly used to generate fog - the noxious fumes produced by fireworks and other pyrotechnic devices with all their problems of control and safety gave way to the first examples of what we recognize today as a 'fog machine'. These first machines all hinged around heating mineral oil by one means or another. The most successful were based on existing insect spraying equipment and used a liquid hydrocarbon, typically oil or petroleum based fluid, which was vaporized in a heat exchanger to produce a dense mist. The problems with these oil-

based machines were many. The oil used could be mildly toxic and the droplets emitted were at a very high temperature and could burn. The fog was often foul-smelling, a murky brown colour and would re-deposit on surrounding equipment leaving an oily film - perhaps on electrical equipment or film camera lenses giving an unintended soft focus vignette.

The situation has improved enormously in recent years however. Germany is normally credited with the development of fluids consisting of mixtures of polyfunctional alcohols (such as glycols and glycerin) as smoke producing agents. Fog produced by atomizing these fluids is dense, white and odorless. As an aside, odor is not really important in television or film (Early experiments with injecting smells into Movie theatres and scratch-and-sniff TV have not been very successful) - still it can be used to great effect in fogs in theatres, night clubs and, perhaps most effectively, in theme parks where a suitable odor can add extra life to a simulation. To return to the point, the use of non-toxic, pure, food-grade chemicals coupled with modern electronics has enabled manufacturers to produce a safe range of different fluids suited to different applications.

There are various parameters we can control with these machines:

- Dissipation speed
- Optical density
- Physical density (weight)
- Color

To take the first parameter, dissipation speed: By altering the relative mixes of the various glycols used mists can be produced with a large range of dissipation times. Typically manufacturers produce a number of grades from Haze to Long lasting - the use of these is fairly self-explanatory; if you want a dense 'pea-souper' use a long lasting fluid; for a short effect in a television production perhaps a haze would be more appropriate. Whichever you use the effect you get is closely linked to our second parameter.

Density: nearly all models of machine have some means of controlling the volume output of fog, but perhaps more important than the actual amount emitted is how it is dispersed into the air. Just 'jetting' fog straight out from the machine onto a stage or into a studio will produce a large, dense cloud which will only slowly spread out - producing a quite localized effect - perhaps fine for a special effect but not quite so good as a dramatic mist or atmospheric haze. A simple fan can

change this, giving quick even coverage over a wide area. Coupled with a long-lasting fluid this can give you a low-level residual mist ideal for defining light beams.

The next parameter, physical density or weight, really only comes into play when you are using one of the more recent additions to the smoke-machine range, Chiller Module type machines such as the High End Coldflow. These units use either liquid CO^2, ice or refrigeration plants to chill the glycol fog down to around freezing point. This increases the physical density enough to make the fog heavier than air so it will sink to the floor or cascade in slow 'waterfalls' giving the effect traditionally produced by solid $C0^2$, 'dry -ice' .

A different mix of fluid can be used for these 'chilled' machines, designed to evaporate and disappear as the fog warms up so it is never seen to rise in the air. These special fluids can also be used to advantage in normal 'room temperature' machines. The mist produced can be very short-lived and appear and disappear on cue. Ideal perhaps for effects such as rocket ship exhausts or factory scenes where a ' jet' has to be briefly seen but mustn't subsequently fill the stage or studio. You could even use a very short duration fluid to simulate the steam jets used in the Paris Opera House in 1890!

You cannot add dyes to fog fluid to color the output as the dye will eventually drop out to form a colored film and will dye clothing, scenery and everything else as well. That’s where lighting comes in - white fog is colored by light much more effectively and creatively than you could ever do with dyes.

A lot of the stigma of the old oil-based smoke machines still lingers on and it is often heard that smoke is dangerous, makes you cough or is bad for singers voices. With a modern fog machine from a reputable manufacturer these should not be issues. All the major manufacturers take their responsibilities here very seriously and continually have their machines and fluids tested by independent laboratories throughout the world. Any coughing caused is usually purely psychological and the fog contains no toxic elements known to affect the vocal cords. The only temporary effect can be a drying caused by the hygroscopic (water absorbing) nature of glycols. So you can be reassured that you are not harming your health by using a fog machine. A point to bear in mind is that even though this type of ‘smoke’ does not contain carbon particles it will still trigger most types of smoke detectors - you have been warned!

Well, that's the history - where are we today? Increasingly it has become apparent that the most common use for fog is as a very fine mist to accentuate light beams. Oil 'Crackers' appeared first using compressed air to atomize mineral oil. Originally crude machines developed 'on the spot' by special effects personnel on film sets they have developed into sophisticated portable machines producing long lasting diffuse oil hazes. Because of the concern over long-term oil build up as mineral oil effectively never evaporates much research has been done to refine the technique using other working fluids.

This research coupled with improvements in nozzle design has resulted in machines such as High End's Nebula Hazer. These machines use a medium density, low vapor pressure glycol mix to give a long hang time for the haze coupled with reduced build-up. Using this type of machine is very different from a conventional fogger. The haze can be allowed to build over a period of minutes or even hours producing a flat, even haze.

In conclusion there is a very wide range of products available today to suit the needs of any lighting designer in any situation, the trick is to know what to use, where and when.

No Smoking!

Mike Wood