COMPOSITE SMOKE
PRODUCTION KIT

MOISTURE RESISTANT CASTABLE RESIN BOUND SMOKE MIXTURES

INSTRUCTION BOOKLET

GENERAL BACKGROUND AND PROCEDURE

The introduction of plastic or rubber resins in smoke mixtures serves a number of useful purposes including but not limited to;

1) The addition of resins improves the moisture resistance and subsequent shelf life many times over that of ordinary loose or pressed powder formulations.

2) Resin composites can be cast or extruded into most any form - including cored grains to increase surface area of burn which increases smoke volume dramatically. Upon curing, they retain their cast shape without additional support.

3) No special casings are required to produce good smoke. The composite may be molded or cast into pellets or other forms and cured to retain the desired shape according to the application.

MATERIALS REQUIRED

A) Composite smoke production package or same individual ingredients.

B) Accurate scale measuring in grams (down to 1/10 th increments thereof).

C) Miscellaneous mixing equipment including 3oz paper cups, paper bowls, measuring spoons, aluminum, brass or wood mixing rod, paper towells, etc..

D) Suitable containers to cast smoke composite into for use including but not limited to; small discarded soup or tomato paste cans, discarded aluminum pop or beer cans, *convolute or spiral wound paper casings of 1" ID or larger, or for pellets, aluminum foil wrap.

E) Sodium bicarbonate (baking soda) optional.

*Paper casings should be treated with a fire retardant solution to avoid combustion and the possibilities of spot fires when using.

MEASURING AND MIXING PROCEDURE

First, using a good scale, take a tare on your mixing container by placing it on your scale and "zeroing" the weight so it indicates zero weight with the container on it. This first container should be a paper or light plastic bowl or something similar which is large enough to hold and mix your entire batch of composite propellant. The second container used (zeroed out according to its weight as well) may be a paper cup large enough to hold the individual ingredient weights as they are being weighed and added to the mixing bowl.

Weigh out the appropriate amount of polymer into the mixing bowl and set aside. Take a tare on the second container (as listed above) and weigh out the rest of the ingredients (**except epoxy curative**) one by one adding each to the mixing bowl containing the polymer. Mix thoroughly until well blended and add the appropriate weight of epoxy, mix again to thoroughly homogenize and extrude or mold the composite into the desired container or shape for curing (see diagrams). Note; the key to a successful composite is the mixing. Once properly weighed, the mixture must be well homogenized in order to cure properly into a rubbery matrix so don't scrimp on the mixing process.

COMPOSITE SMOKE FORMULATION

% by weight unless otherwise noted

INGREDIENT	FORMULA	WEIGHT	APPLICATION
Ammonium Perchlorate, 200 micron	NH_4ClO_4	31.00%	oxidizer
Zinc Oxide, powder	ZnO	18.00	smoke colorant
Dechlorane **or**	$C_{10}Cl_{12}$		
Hexachloroethane	C_2Cl_6	13.00	smoke
Ammonium Chloride	NH_4Cl	11.00	smoke
PBAN polymer	PBAN	10.00	fuel / binder
2-Ethylhexyl Acrylate	EHA	5.00	plasticizer
Sodium Bicarbonate (baking soda)	$NaHCO_3$	4.00	stabilizer / CO_2
DER-331 or Shell 828 Epoxy	Epoxide	3.00	curative
Sulfur	S	2.00	combustion
Versamid 140	Polyamide	2.00	cure accelerator
Ferric Oxide (red iron oxide)	Fe_2O_3	1.00	catalyst
		100.0%	Total

Solids loadings	80.00%
Cure temperature	140-160^0 F
Hours to cure @ 160^0 F	8 to 9 (tackless) approximately
* Burn rate - 85 grams, solid	29 seconds (using $C_{10}Cl_{12}$ and $NaHCO_3$)
* 85 grams cured in 2" ID x 2	1/4" long paper casing - open top

The sodium bicarbonate is optional. It is used to increase the combustion rate of the composite to increase smoke volume and cloud density. When added, it reacts with the acidity of the polymer forming gas which is trapped in the composite as it cures forming bubbles (similar to a sponge). These bubbles increase the surface area of burn which in turn, increases burn rate and pressure. If left out, the amount of gaseous product or "foaming" is reduced and the composite will cure to a more dense structure which in turn slows the combustion rate for a longer burn duration with less smoke volume per second being produced.

To create the highest possible density using this formulation, leave out the sodium bicarbonate and add one drop of polydimethylsiloxane (PDMS) per pound of composite mix. PDMS helps control foaming which reduces gas formation. It is available from Firefox Enterprises Inc..

INSECTICIDE SMOKE — % by weight unless otherwise noted

INGREDIENT	FORMULA	WEIGHT	APPLICATION
Ammonium Perchlorate, 200 micron	NH_4ClO_4	35.00%	oxidizer
Zinc Oxide, powder	ZnO	24.00	smk / absorbent
Dechlorane **or**	$C_{10}Cl_{12}$		
Hexachloroethane	C_2Cl_6	18.00	smoke
PBAN polymer	PBAN	11.00	fuel / binder
* Pyrethrin, 6% concentrate	-	4.00	toxin
Sulfur	S	3.00	combustion
DER-331 or Shell 828 Epoxy	Epoxide	3.00	curative
Versamid 140	Polyamide	2.00	cure accelerator
		100.0%	Total

Solids loadings	80.00%
Cure temperature	140-150^0 F

* Most any strong insecticide may be used including many garden varieties. Here, they are not diluted and the best to use are oil based. We used Pyrethrin concentrate (6%) that we obtained from a local farm supply for crop dusting. When using garden type insecticides, use full strength. It may also be necessary to increase their percentage one or two percent to obtain good knock down power but test a device as is first before increasing this percentage. The higher this percentage in the formulation, the longer they will take to cure.

Be careful with the insecticides. Use rubber gloves and proper eye and respiratory protection when weighing, mixing and handling and treat them for what they are - **poisons!** Note; when mixing the insecticide smoke composite, do so in a well

ventilated area and avoid breathing of vapors. Use common sense and never use the completed devices around pets, farm animals or children. Store completed devices and left over materials out of reach of children and pets in a locked storage area.

CURING

Never cure these devices in your kitchen oven! Some of the curing gasses - especially from the insecticidal smoke mix may be toxic (do not breathe the smoke produced during operation for the same reason)! Instead, construct a wood or metal box under cover out of doors to hold the devices and place a 150 watt light bulb for heat. Monitor with a thermometer keeping the cure temperature between the two figures listed by adjusting the air flow allowing for circulation. The air flow is produced by one or more small 1 1/2" diameter holes - one in each opposite end. An old refrigerator or a 30 to 55 gallon metal drum will also work for a curing chamber as well as a small electric ceramic heater with adjustable thermostat for the curing heat.

Leave the devices in the curing chamber under heat until they are fully cured which is until they are not "tacky" to the touch. Leaving them in the chamber longer to ensure complete cure will not harm them. You cannot "overcure" the composite, however, do not exceed the maximum curing temperature as listed.

FUSING

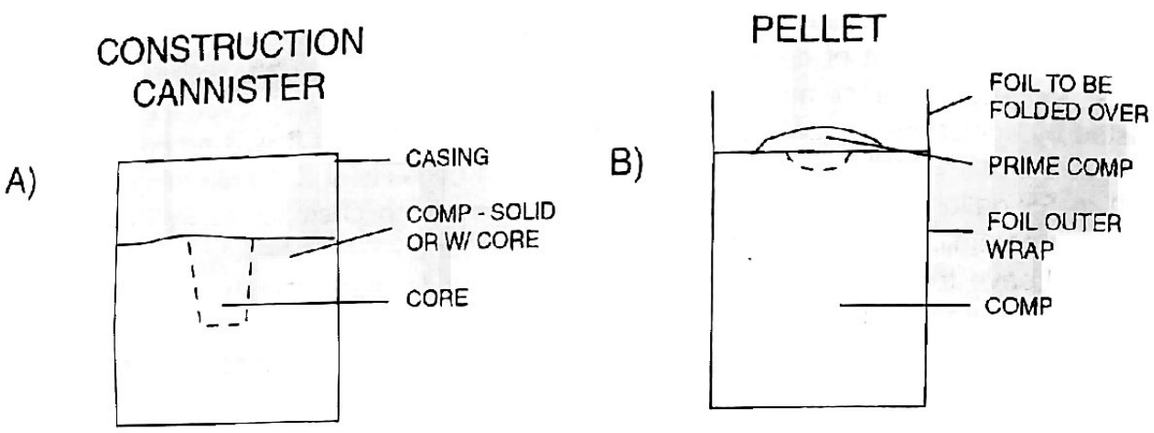
Ordinary safety fuse may be used for ignition by making a hole approximately 1" deep in the cured composite with an awl, tie a knot in the end of a length of fuse and force it into the hole. If this does not reliably ignite the composite, a small amount of prime composition at the bottom of the fuse hole should ensure ignition. The following prime formulation may be used;

PRIME COMPOSITION

INGREDIENT	FORMULA	WEIGHT	APPLICATION
Potassium Nitrate, powder	KNO_3	67.00%	oxidizer
Aluminum, fine flitter 40-270 mesh	Al	18.00	fuel, thermic
Silicon, black pyro fine	Si	8.00	fuel, hot slag
Ferric Oxide (red iron oxide)	Fe_2O_3	5.00	fuel, hot slag
Charcoal, air float	C	2.00	ignition ease
* Nitrocellulose lacquer, solution 75/25 NC lacquer/Acetone	$(C_6H_{10}\text{-}x(ONO_2)x)n$	to slurry	binder

* The prime composition may be used in the dry form but it is better to make a thick batter-like slurry using NC lacquer solution and "cement" the fuse in place with it. This prime slurry is also used to coat the top of the composite pellets so they can be ignited without fuse using a match.

CONSTRUCTION



A) The cans are filled approximately 60% full if a lid and vent are to be used or 90% if no top cap is used. The vent should be 50% smaller than the inside diameter (ID) of the casing - no smaller.

B) Making the "can" to place the composite forming the pellet is accomplished by wrapping 2 to 3 turns of aluminum foil around a suitable size dowell and folding it over the end forming a bottom. The can is filled with uncured composite leaving enough foil to fold over the top end when cured and primed to close. To use, simply peel back the loose top foil and ignite the prime with a match.

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