MANISH SISODIA
मनीष सिसोदिया

सत्यमेव जयते

DEPUTY CHIEF MINISTER
GOVT. OF NCT OF DELH
उप मुख्यमंत्री, दिल्ली सरकार
DELHI SECTT, I.P. ESTATE
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D.O. No. F.9.1/EC/Env/2016-17/5040
Date : 27 September, 2017

Dear Principal,

Greetings from the Government of NCT of Delhi on the eve of festive season.

You must be aware that air pollution affects the health of all living beings. During Diwali, which is a festival of light and happiness, the pollution levels increase manifold due to bursting of fire crackers/fireworks. The Department of Environment, Government of NCT of Delhi organizes Anti-Fire Cracker campaigns to control Air and Noise Pollution every year. Children play a major role in the success of this campaign.

The Eco-Clubs in schools/colleges always played an important role in the Anti-Fire Cracker and other environmental campaigns. The **"NO USE OF FIRE CRACKERS"** campaign may be spearheaded by your Eco-Club through Nukkad Nataks, Padyatras, Expert Lectures, Workshops etc. involving the children of your esteemed school.

Let us reach out to the citizens of Delhi through your activities and make the Anti-Fire Cracker campaign a huge success.

Also a Circular from Central Pollution Control Board (CPCB) is attached regarding chemical composition of fire-crackers.

The Government of NCT of Delhi wishes a **Safe and Happy Diwali** to all our citizens.

(MANISH SISODIA)

केन्द्रीय प्रदूषण नियंत्रण बोर्ड
पर्यावरण एवं वन मंत्रालय
(भारत सरकार)

Central Pollution Control Board
Ministry of Environment & Forests
(Government of India)
Phone: 22307078/22303655

ए.बी. अकोलकर
सदस्य सचिव
A.B. AKOLKAR
Member Secretary

File. No 79/RD-FC/UPCD/2017 5722

Date: 14.07.2017

Delhi Pollution Control Committee
Daily No. 8622
25 JUL 2017
MS
Sign. of Receiving Officer

MS/568
25/07/17

To,

The Member Secretary
Delhi Pollution Control Committee
4th floor, ISBT Building, Kashmiri Gate
Delhi – 110006

Sub: Circulating of information on firecrackers for generating 'Public Awareness for firecrackers' as per the deliberations under the Writ Petition (Civil) No. 728/2015 regarding Chemical Composition of FIRECRACKERS in the Hon'ble Supreme Court – reg.

Sir,

This has reference to the deliberations of the last hearing dated: 07-07-2017 of the aforementioned case wherein the Hon'ble Supreme Court called upon the DPCC/Delhi Govt. to explore the possibility of generating 'Public Awareness regarding health hazards of firecracker' by circulating relevant information as highlighted in CPCB's Affidavit, that was submitted to Hon'ble Supreme Court as an Annexure (Page – 68 enclosed). The same may be circulated to all Schools in Delhi (all Govt., Private, NDMC, MCD and Delhi Cantonment Schools).

An intimation regarding action taken in this regard may kindly be forwarded to this office.

Yours faithfully

(A B AKOLKAR)

Enclosed: as above

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ANNEXURE-VII

Known Health Impacts From Bursting Firecrackers Caused Due To Their Chemical Composition

1. **Ingredients used in FOUR commonly used sound producing fire crackers**

The Hon'ble Supreme Court of India has banned the bursting of fire-crackers or any noise generating fireworks of high decibels to control the noise pollution. The Petroleum and Explosive Safety Organisation (PESO) (formerly Dept. of Explosives – *DOE)* has identified FOUR commonly used sound producing fire crackers namely:

a. Atom Bomb
b. Chinese Crackers (no related to any country)
c. Maroons
d. Garland crackers

The focus has been on the following four ingredients - aluminium powder, sulphur, KNO_3 & $BaNO_3$.

Table 1: Usage of ingredients in FOUR common firecrackers

Ingredients	Major uses
Potassium nitrate **(Oxidizers)**	Oxidizer used as component of black powder. It is usually employed in safety fuses and lift charges
Barium nitrate **(Oxidizers)**	It can be used as oxidizer and green color agent in flames, smoke, and flash mixtures. It can produce white or silver effect with aluminium
Aluminium **(Fuel)**	It is the most widely used fuel. It produces brilliant flames and white sparks
Sulfur **(Fuel)**	Used in white and colored smoke composition, flash and sound blends. It is a component of black powder. It could also be used as oxidizer in some mixtures

2. **Chemical composition adds sparkle , colour & sound to firecrackers**

Light and Colour are important aspects of fireworks which depend on two basic physico-chemical properties:

a) Incandescence: Huge amount of heat is required to generate colour which needs instantly sets of chemical reactions within the ingredient mixture of the firecrackers. For example change of colours from red, orange, yellow, and white light as the mixture gets increasingly hot.

b) Luminescence: This feature also needs energy

Table 2: Colour producing compounds used in firecrackers

Metal & Its Compounds	Colour
Strontium Salts & Lithium Salts (Li2CO3, SrCO3)	Red
Calcium Salts (CaCl2, CaSO4.2H2O)	Orange
Incandescence of Iron or Charcoal	Gold
Sodium Compounds (NaNO3, Na3AlF6)	Yellow
White Hot Metal (BaO)	Electric White
Barium compounds with Chlorine (BaCl+)	Green

Copper Compounds and Chlorine, $Cu_3As_2O_3Cu(C_2H_3O_2)_2$	Blue
Mixture of Strontium (red) and Copper (blue) compounds	Purple
Burning aluminium, titanium or magnesium powder	Silver

3. Chemistry of fireworks

Charcoal is the most commonly used fuel in the industry. The chemistry of fireworks is based on combustive features of the ingredients used and the lighting effects that are generated.

Based on literature survey the following are the key ingredients that go into making fireworks:

i. Fuel: Charcoal i.e. black powder is the most common fuel used in fireworks.
ii. Oxidizing Agents: The function of the oxidizing agent is to produce the oxygen needed in order to burn the mixture within the fireworks. It can be nitrates, chlorates or per-chlorates etc.
iii. Reducing Agents: It needs to burn oxygen provided by the oxidizing agents. Common reducing agents are Sulphur and Charcoal and these react with oxygen to form sulphur dioxide and carbon dioxide respectively
iv. Regulators: Metals (like aluminium, titanium, copper, strontium, barium etc.) can be added to regulate the speed of the reaction and colouring agents.
v. Binders: Binders are used to hold the mixture of the firework together in a paste like mixture. The most commonly used binder is known as dextrin, a type of starch. Paron can also be used in binding, however it is less common and only used in conjunction with red and green fireworks as it helps to enhance their colour. The binders do not actually begin to work until the firework has been lit and are potentially dangerous.
vi. Colouring Agents: Different chemicals are used to produce coloured fireworks.

Table 3 : Summary of chemicals used causing sparkling effects in firecrackers

Chemical Compounds	Purpose usage	Chemical Compounds	Purpose usage
Lead Dioxide / Nitrate / chloride	oxidizer	Aluminium	Brilliant whites
Lithium compounds	blazing reds	Potassium Nitrate	In black powder
Mercury (Mercurous chloride)	chlorine donor	Ammonium & Potassium	propellant / oxidizer
Barium Nitrate	glittering greens	Copper compounds	blues
Arsenic compounds	Used as colorants	Antimony sulfide	glitter effects

4. Non – stochiometric ingredients in firecrackers impact health

The lighting effects and noise levels depend on the chemistry of fireworks and the combustive features of the ingredients, the major concern being inappropriate stochiometric amounts of the ingredients in making common firecrackers. Firecrackers are made of chemicals/metallic agents some of which are toxic when they are burst. The major constituents of smog that forms from firecracker emissions contain SOx, NOx and significant dust load or particulate matter that may contain the any of the following

heavy metals ex. Pb, Hg, Sr, Li, Al etc. Table below provides an overview of immediate/long term effects of commonly used ingredients used in making firecrackers.

Table 4 : Environmental health Effects - Hazardous & toxic nature of ingredients used in firecrackers

Compound	Environmental health Effects
Aluminium	Contact dermatitis, bioaccumulation
Sulfur Dioxide	Acid rain from sulphuric acid affects water sources, vegetation & causes property damage.
Potassium Nitrate	Toxic dusts, carcinogenic sulfur-coal compounds
Perchlorate - Ammonium & Potassium	Can contaminate ground & surface waters, can cause thyroid problems in humans & animals
Barium Nitrate	Poisonous. Fumes can irritate respiratory tract. Possible radioactive fallout.
Copper compounds	Polychlorinated dioxins and di-benzofurans. Can bio-accumulate. Cancer risk.
Antimony sulfide	Toxic smoke, possible carcinogen
Lead Dioxide / Nitrate/Chloride	Bio-accumulation, developmental danger for kids & unborn babies, may remain airborne for days, poisonous to plants & animals
Lithium compounds	Toxic and irritating fumes when burned
Mercury (Mercurous chloride)	Toxic heavy metal. Can bio-accumulate.
Nitric oxide	Toxic by inhalation. Is a free radical
Nitrogen dioxide	Highly toxic by inhalation.
Ozone	Greenhouse gas that attacks & irritates lungs
Arsenic compounds	Toxic ash can cause lung cancer, skin irritation and wart formation.
Strontium compounds	Can replace calcium in body. Strontium chloride is slightly toxic.

References:

1. C. Martín-Alberca, C. García-Ruiz/ Trends in Analytical Chemistry 56 (2014) 27–36 ; Analytical techniques for the analysis of consumer fireworks, (Elsevier : https://www.researchgate.net/publication/260030498_Analytical_techniques_for_the_analysis_of_consumer_fireworks)
2. http://www.backcountryattitude.com/toxic_fireworks.html)

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