TOXICS LINK
For a toxics free world
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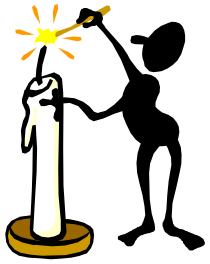
Cracking down on crackers



What comes to your mind when you think of Diwali? Lights, lamps, candles, sweets, rangoli, new dresses, family reunions, rituals, but mainly bursting crackers. In fact, crackers have become an integral part of the festival, to the extent that Diwali today, is almost solely associated with the sound of crackers.

But did you know that Diwali was never such a sound filled festival? Traditionally it was a festival of lights, when houses were decorated to propitiate goddess Lakshmi and for attainment of health, wealth, wisdom, peace, etc.

However, over the years, the festival has lost its sanctity and has turned into a festival of pollution, noise, crackers, artificially coloured sweets and serious health hazards. On this day, cities turn into gas chambers, as burning of crackers increases toxic fumes and gases like carbon dioxide, sulphur dioxide and nitrogen dioxide, as well as suspended particulate matter (SPM), in the air.

According to doctors, the worst affected during this festival are the children, pregnant women and those suffering from respiratory problems. Diwali crackers cause throat and chest congestion, and are likely to aggravate problems for those already suffering from coughs, colds and allergies. According to Dr Rajesh Chawla of Apollo hospital, the level of suspended particles in the air increases alarmingly during Diwali, causing eye, throat and nose problems. Although most of us do not feel the immediate impact, these problems can later develop into serious health hazards.

Facts about bursting crackers

- An increase in air pollution by six to ten times on Diwali in terms of SPM, nitrogen oxides (Nox), sulphur dioxide (SO_2), etc.
- An increase in noise pollution above 125 decibel (dB), which is above the tolerable limits, and can cause deafness.
- An increase in incidents of respiratory diseases such as acute bouts of asthma, bronchitis and heart attacks.

Source: Delhi Pollution Control Committee

According to senior meteorological department officials, Diwali-related pollution has a bearing on the atmospheric temperature. Extensive bursting of crackers may lead to an increase in temperature by as much as two degrees celsius, especially in densely populated areas, during those two days.

And its not just us who bear the brunt of air pollution caused by crackers, even mute trees are not spared. According to Dr Iqbal Malik of Vatavaran, "scores of crackers that go up in smoke, burden the trees with thick layers of sulphur dust as well as particulate matter, thereby preventing them from basic functions like breathing." The edges of the stomata, the breathing pores, get damaged and have signs similar to burn injuries. Even the fruits on the trees get blackened due to cracker smoke. According to Dr Malik, the best remedy for plants to survive this toxic onslaught is give them a thorough wash the next morning to rid them of the harmful chemicals that settle on the leaves.

Crackers not only cause air pollution, but are also responsible for huge noise pollution. According to a study conducted in China, sound levels produced by fire crackers reach instantaneous peak levels of 145 to more than 160 dB at the ear of an observer standing at 2 meter from a firecracker lying on a hard surface. These levels match those produced by firearms: from 145 dB for a carbine, to 152-155dB for a rifle, and up to 160 dB for a pistol at the ear of the gunman. Experience with noise from firearms has clearly demonstrated that impulse sounds reaching these peak levels are potentially hazardous to the ear, the reason why hearing protection is commonly used in outdoor shooting facilities.

In order to assess the noise level on the occasion of Diwali, the Central Pollution Control Board monitored noise levels at various areas of Delhi on the day of Diwali, as well before Diwali. The following are the results of their monitoring:

No.	Location	1998 Pre Diwali Decibel (dB)	1998 Diwali Decibel (dB)	Increase Decibel (dB)	1999 Pre Diwali Decibel (dB)	1999 Diwali Decibel (dB)	Increase Decibel (dB)
1	Nand Nagari	53.8	79.1	25.3	70.2	81.5	11.3
2	Taj Enclave	58.5	78.8	20.3	63.2	76.3	13.1
3	Naroji Nagar	59.8	72.5	12.7	55.3	84.9	29.6
4	Vasant Kunj	49.4	76.9	27.5	50.7	65.0	14.3
5	Lajpat Nagar	59.1	74.4	15.3	66.9	75.0	8.1
6	Shanti Vihar	52.8	85.8	33	70.1	79.1	9
7	Karol Bagh	64.5	89.2	24.7	66.2	81.3	15.1
8	Moti Bagh	57.9	76.4	18.5	62.0	88	26
9	Pahar Ganj	68.6	82.3	13.7	68.2	88	19.8
10	Patel Nagar	47.4	84.3	36.9	65.0	76.0	11
11	Tilak Nagar	56	70.9	14.9	60.5	83.4	22.9
12	Rohini	60	80.9	20.4	71.5	86	14.5
13	Meera Bagh	47.4	72.6	25.2	60.8	93.8	33
14	Janak Puri	46.9	77.9	31.0	71.6	81.5	9.9
15	Mandavoli	66.6	82.3	15.7	66.2	85	18.8
16	Shalimar Bagh	52.9	92.3	39.4	65.7	86	20.3
17	Def. Colony	59.2	--	--	64	80.3	17.7

18	Rajpura Road	46.4	--	--	67.3	85	17.7
19	G..Kailash	59.3	69.6	10.3	68	66.3	-1.7

Source: Central Pollution Control Board

The recent direction by the Delhi High Court imposing a ban on high noise crackers to limit the air and noise pollution caused by them has come as a relief. The bench has also asked the firecracker industry to strictly adhere to the statutory provisions of the Ministry of Environment and Forests (MoEF) by marking the level of pollution to be caused by the firecrackers, especially, rockets and atom bomb on their packaging. Therefore, any cracker making a sound of more than 125 dB, i.e., equivalent to sound of a car tyre burst, cannot be used during festivals.

To study the chemical composition, particularly of metallic and non metallic components of crackers, Toxics Link got some samples of sparklers ("phuljari" in Hindi and "mathappu" in Tamil) and pots ("anar" in Hindi and "pusvanam" in Tamil) analysed at the Bombay Natural History Society Laboratory, Mumbai.

The results showed highly toxic heavy metals like cadmium and lead in addition to other metals like copper, manganese, zinc, sodium, magnesium and potassium. Both nitrates and nitrites of few of these metals were present. Both these radicals are oxidising agents which are a ready source of oxygen in the process of combustion. In addition, oxides of sulphur in the form of sulphate and phosphorous in the form of phosphate were present in the samples. The mean levels of cadmium in the crackers analysed were 5.2 mg/100g. Anar and wire showed 6 and 8mg/100g, respectively. The mean level of lead was 462 mg/100g with a maximum in green sparkle showing 850mg/100g. Magnesium was found in huge quantities when compared to other metals like copper, manganese and zinc. The mean levels of magnesium was 2622mg/100g and of copper was 744mg/100g. Zinc was the least among the various metals detected with a mean level of 324mg/100g.

Four acidic radicals --nitrate, nitrite, phosphate and sulphate-- were also detected. The proportion of nitrite, phosphate and sulphate in the crackers was almost similar and ranged between 1160 to 1420 mg/100gm, while nitrates which are strong oxidising agents, were found in considerable amounts when compared to the other three. Their mean levels were 1624mg/100g. Among these, oxides of sulphur, phosphorous and nitrogen are very corrosive and highly acidic while carbon monoxide, one of the oxides of carbon is an extremely poisonous gas whose presence cannot be detected by our sensory system as it is odorless. Carbon monoxide combines more than 200 times as readily as oxygen, so that low concentration levels have adverse health effects. Exposure to 100 ppm results in headache and reduced mental acuity. The effects are more pronounced in people with heart, lung or central nervous system diseases. The mode of entry of these oxides is through inhalation. In contact with moisture (water) within the respiratory passage (from nostrils to the lungs), these oxides combine to form acids of sulphur, phosphorous and nitrogen.

Sulphur dioxide is readily soluble and dissolves in the larger airways of the respiratory system. This stimulates a contraction at 2 to 5 parts per million (ppm). At higher concentrations severe contraction restricts the breathing process. Nitrogen dioxide is less soluble and so penetrates to the smaller airways and into the lungs. They destroy the linings

of the respiratory surface, thereby reducing the intake of oxygen for the body. These cause respiratory allergies like asthma especially to the susceptible population.

According to Dr Amit Nair, toxicologist, there is an exposure to unburnt material in the cracker in addition to exposure to the suspended particulate materials which are invisible to the naked eyes. These particles are very small (1 to 5 microns in size) and contain metals along with carbon. There are no reports on their toxicological effects in the human body, nevertheless, metals like cadmium and lead, even in very small concentrations are undesirable elements and toxic. Though occupational exposure to these metals cannot be compared to the short-term ambient exposure during Diwali, its significance in terms of human toxicity cannot be ignored due to the sheer amount of crackers burnt during Diwali. While the consumers are exposed to the chemicals in the crackers only during the festival, the workers, majority of whom are children, are the worst affected since they are exposed to these chemicals continuously throughout the year. They come in contact with salts of metals and oxides of non-metals such as sulphur and phosphorous, which act as fuels, oxidising and coloring agents. Heavy metals such as cadmium and lead are not required by the body and even in small quantities, they can disrupt the normal functioning of the humans.

Following are the results of the analysis:

Parameter	Red Sparkler (mg/100g)	Green Sparkler (mg/100g)	Gold Sparkler (mg/100g)	Pot (Anar) (mg/100g)	Wire (mg/100g)
Cadmium	4	3	5	6	8
Copper	800	8.5	670	680	720
Lead	420	4.3	460	380	.62
Magnesium	2520	25.8	2620	2560	2830
Manganese	700	6.8	650	580	540
Potassium	1680	16.2	1690	1720	1760
Sodium	1120	11.4	1130	1090	1080
Zinc	280	3.2	340	360	320
Nitrate	1720	15.4	1560	1620	1680
Nitrite	1230	12.1	1180	1220	1160
P as PO_4	1420	16.2	1340	1320	1310
S as SO_4	1280	1180	1.36	1380	1390

Health effects:

Copper: Poison to humans by ingestion. Inhalation of copper dust and fume causes irritation in the respiratory tract. Absorption of excess copper results in "Wilson's disease" in which excess copper is deposited in the brain, skin, liver, pancreas and myocardium (middle muscular layer in the heart).

Cadmium: Can be poisonous to humans by inhalation, ingestion, intraperitonial, subcutaneous, intramuscular and intravenous routes. Cadmium absorption can damage the

kidneys and can cause anaemia. It is a potential human carcinogen. Cadmium causes increased blood pressure and also a disease called "Itai--Itai", which makes bones brittle resulting in multiple fractures.

Lead: Affects the central nervous system in humans. A poison if ingested, moderately irritating. It can cause cancer of lungs and kidneys and an experimental teratogen. **When heated it can emit highly toxic fumes.** In inorganic form, it is a general metabolic poison and an enzyme inhibitor. Young children can suffer mental retardation and semi-permanent brain damage by exposure to lead. Incase of lead levels in blood, the disturbing feature is that the natural levels are very close to the lowest safety limits.

Magnesium: Poison by ingestion, inhalation of magnesium dust and fumes can cause metal fume fever. Particles embedded in the skin can produce gaseous blebs and a gas gangrene. **Dangerous fire hazard in the form of dust or flakes when exposed to flames.** Manganese in the air has adverse effects on humans. Poisoning takes the form of progressive deterioration in the central nervous system.

Manganese: An experimental carcinogen and mutagen. Human toxicity caused by dust or fumes. The main symptoms of exposure are languor, sleepiness, weakness, emotional disturbances, spastic gait and paralysis.

Potassium: Dangerous fire hazard. If there is any confinement, an explosion can occur.

Sodium: In elemental form, it is highly reactive, particularly with moisture with which it reacts violently and therefore can attack living tissue. When heated in air, it emits toxic fumes of sodium oxide. **Dangerous fire hazard when exposed to heat and moisture.**

Zinc: Human skin irritant and effects pulmonary system. Pure zinc powder is non-toxic to humans by inhalation but difficulty arises from oxidation (burning), as it emits zinc fumes. Zinc is perhaps the least toxic of all heavy metals, infact an essential element in animal and human nutrition, still they become toxic when absorbed in excess. Zinc stimulates the sensation of vomiting. An exposure to 150 mg of zinc can stimulate the process of vomiting in an adult male.

Nitrate: Large amounts taken by mouth can have serious and even fatal effects. The symptoms are dizziness, abdominal cramps, vomiting, bloody diarrhoea, weakness, convulsions and collapse. Small repeated doses may lead to weakness, general depression, headache and mental impairment. Also there is some implication of increased cancer incidents among those exposed. Highly inflammable and on decomposition they emit highly toxic fumes.

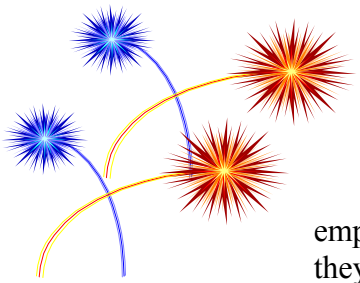
Nitrite: Large amounts taken by mouth may produce nausea, vomiting, cyanosis, collapse and coma. Repeated small doses can cause a fall in blood pressure, rapid pulse, headaches and visual disturbances. **When heated, emit highly toxic fumes of NOx.**

Phosphorous in PO_4: Poison to humans. Dangerous fire hazard when exposed to heat or chemical reaction. Poison by inhalation, ingestion, skin contact and subcutaneous routes. Ingestion affects the central nervous system. Toxic quantities have an acute effect on the liver, can cause severe eye damage.

Sulphur in SO_4: Poison to humans by inhalation an eye, skin and mucous membrane irritant and corrosive, an experimental carcinogen. It chiefly affects the upper respiratory tract and the bronchi. It may cause edema of the lungs or glottis, and can produce respiratory paralysis.
Source: Hazardous Chemicals Desk Reference, N.Irving Sax and Richard J.Lewis

Apart from being a toxic industry, firecrackers are a potential fire hazard and the risk is increased manifold during Diwali time. According to Mr. S. Ramani, Director of Tamil Nadu Fire Services (TNFS), fire accidents are widespread in the state. In 1998, the number of fire accidents in Chennai alone was 146 and, in 1999 it was 106 (inclusive of 2 large slums). He extrapolates the situation to other metropolises such as New Delhi, citing the episode of a blast in a cracker shop last year that resulted in a major disaster with several casualties. "Rockets are the primary reasons for such accidents", he says. "Though a total ban on crackers for this reason may not be plausible, the Tamil Nadu Government is considering a ban on the sale of rockets alone during Diwali", he added. The TNFS plans to conduct an anti-pollution drive before Diwali to highlight the pollution caused by firecrackers.

The firework industry in India produces roughly Rs 250 crores worth of fireworks annually. Crackers are made in Uttar Pradesh, Rajasthan, West Bengal, Haryana and Madhya Pradesh, with the infamous Sivakasi (90% of the production), Virudhunagar and Sattur districts of Tamil Nadu being the largest producer of crackers. According to studies conducted by the Ministry of Labour and some NGOs, most of these factories flout the Labour laws and Explosives and Factory Act and exploit the children. Out of the 11 million child labourers in India, approximately one lakh are employed in the fire works industry alone. Mostly young children are employed because cracker making requires small and tender hands. Some of the children employed are as young as 3 years and as they attain the age of 15-16, they are thrown out of the job by the employer. These children work for a grueling 16--18 hours each day in unhygienic, dingy, make-shift and suffocating factories-- all for a pitiful sum of Rs 10 -15 per day. Children in these factories handle chemicals like sulphur, potash, phosphorous, nitrates and chlorates that cause deadly diseases of the lungs, kidneys, skin and eyes. Incase of an accident, these children get trapped and are suffocated to death as was reported in 1995 in Rohtak, Haryana where 8 Children were charred in a fire accident.



How to make Diwali pollution free?
An awareness drive on the menace of fire crackers can be a good beginning for a clean Diwali. An excellent example of this is the Department of Environment, Delhi Government's, **"Say No to Crackers"** campaign, in different schools of Delhi which resulted in a decline in sale of crackers by 20 to 30 per cent. As a result, Delhi witnessed a cleaner Diwali last year after several years. According to a survey conducted by the environment department, there was a substantial reduction in a number of pollutant gases. In case of sulphur oxides, 16 locations out of 19 recorded a reduction of up to 89 per cent, while nitrogen oxides showed a reduction of up to 80 per cent at 15 locations. Similarly, carbon monoxide and noise levels showed a reduction at all the monitored locations. Similar initiatives have been taken up in Mumbai by organisations like CRY, YUVA and IIT. They have held poster, slide and film shows to educate children and youngsters about the hazards associated with fire crackers.

Considering these adverse effects, we all must initiate action to put an end to this menace. Let us all decide to avoid the sale, purchase and use of crackers and celebrate the festival in its true spirit by lighting lamps.

If you have more suggestions or require information, please contact:

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