

M. Mata

December 4, 2007

California Regional Water Control
Board:

SAN DIEGO COUNTY
WATER DISTRICT
COMMUNITY DEVELOPMENT
DEC -4 P 3:47

I am enclosing a presentation
I made in front of the Coastal
Commission in 2001 which
include several scientific
articles concerning fireworks
emissions and their toxic effects
on air and water.

Also I am including an article
by the U.S. Environmental Protection
Agency's Richard Wilkin, and
colleagues on effects of environmental
perchlorate contamination in an
Oklahoma lake from fireworks
displays. This was conducted 2004-2006
and detailed in June 1 issue of
the journal Environmental Science +
Technology. Copyright 2007 by UPI.

The second article is by Gunn K.
Attri "Looking at Fireworks from
Environmental Science Perspective."

There have been monitoring done by
Sea World and the SDIC in the last
few years but further studies needs
to done by a more objective scientific group
perhaps Dr. Richard Wilkin from the EPA.
All fireworks should be suspended.

DOCUMENT SCANNED

ON: 12/5/07

BY: Kara Shoemaker

until further & more accurate
studies are done to protect human,
animal, air and water health.

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Fireworks cause environmental pollution

U.S. government scientists say Fourth of July fireworks displays often held over lakes and other bodies of water can pollute the water with perchlorate.

The U. S. Environmental Protection Agency's Richard Wilkin and colleagues, who conducted the research, note concerns have arisen over the effects of environmental perchlorate on human health and wildlife. Sources of perchlorate range from lightning and certain fertilizers to the perchlorate compounds in rocket fuel and explosives.

Scientists long suspected community fireworks displays were another source, but few studies had been done on the topic.

Wilkin's group has now established fireworks displays as a source of perchlorate contamination by analyzing water in an Oklahoma lake before and after fireworks displays in 2004, 2005 and 2006. Within 14 hours after the fireworks, perchlorate levels rose 24 to 1,028 times above background levels. Levels peaked about 24 hours after the display, and then decreased to the pre-fireworks background within 20- to 80 days.

The study is detailed in the June 1 issue of the journal *Environmental Science & Technology*.

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Looking at Fireworks From Environmental Science Perspective

By: Arun K. Attri

Without any hesitation it can be stated that the sparkling and twinkling of coloured lights exhilarates the visual senses of one and all. When this display is coupled with the sound of explosive bursts it is considered an expression of joyous affair; occasion can be marriage, new year, Diwali or any other festival. On the other hand, scientific evidence is mounting to reveal the immediate impact of such firework displays on human health through pollution of air we breathe. Diwali festival had been the focus of scientific investigations related to firework displays and following adverse health impact.

In order to understand the gravity of the adverse health related impact due to the fireworks, it is important to comprehend their basic chemical composition. Firework activation represents a combustion reaction, where the mixed ingredients are burnt. The most basic form of fireworks, known as black powder, was discovered and used in China about 1000 years ago. It was a mixture of potassium nitrate, charcoal and sulfur in 75:15:10 proportion. Black powder, even today, is used as an explosive charge and propellant in shells and bullets. On ignition the mixture produces, instantaneously gases and if the mixture is confined inside a closed space explosion follows. The directed emission of gases can propel the container like a rocket. From chemistry's point of view combustion requires the supply of oxygen; or oxidizing agent capable of supplying large amount of oxygen. Commonly known oxidizers used in fireworks are nitrates, chlorates and per-chlorate compounds. Reducing agent capable of burning in the presence of oxygen supplied by the oxidizer acts as fuel; sulfur and charcoal are few common reducers used in making the fireworks. The loose mixture of oxidizer and reducer is shaped and held together by using binding agent; starch dextrin or gum arabic are common binders used to make the mixture more evenly homogeneous. Bright sparkling colours emitted by different types of fireworks require the addition of metal salts in black powder. Depending upon the composition of oxidizer and reducer used, fireworks on ignition can achieve very high temperature (1000 to 3000 °C). Metals, when heated, at such temperatures, emit radiation covering a wide spectral range, which includes the visible light of characteristic colour.

Some of the common metal salts used to achieve the emission of sparkling colours are: (a) Copper Acetoarsenate [Blue], (b) Copper chloride [Turquoise], (c) Cryolite [Yellow], (d) Lithium Carbonate [Brilliant Red], (e) Barium Carbonate [Green], (f) Barium Chloride [Bright green] etc. In addition, the emission of bright white sparkling light flashes effects require the mixing of magnesium and aluminum salts into the mixture. The human eye can only see the radiation emitted in visible spectral region. One of the little known aspects associated with metal salts emitting radiation or light, when heated at high temperature, was revealed in 2001 (Nature vol 411, pp 1015).

Experiments clearly provided evidence that in addition to the emitting of visually elating colours, metals at high temperature also emit radiation in spectral region known as ultraviolet or UV. Barium, copper, lithium, strontium, manganese, sodium salts when burnt at temperatures produced by the ignition of fireworks emit significant proportion of light having wavelength less than 240 nm (high energy UV radiation). Consequences of this are alarming. First, the person standing in the vicinity, where fireworks are ignited, will be exposed to harmful UV radiation. Second, the high energy UV radiation are readily absorbed by molecular oxygen present in the air. This results in the splitting of molecular oxygen into atomic oxygen [$O_2 + UV(\text{Wavelength} < 240 \text{ nm}) \rightarrow O + O$].

Now, this is serious as atomic oxygen (O), thus produced, is chemically very reactive and on reaction with molecular oxygen produces ozone (O_3), a powerful oxidant. The experiments done recorded precisely this. Fireworks emitting colour on ignition produced a burst of O_3 production in the air surrounding the ignited fireworks. This new finding unfolded another dimension associated with firework displays, i.e. in addition to their potential to pollute the air. Air we breathe, if contains ozone (powerful oxidant) will damage the lung lining. The damage is likely to be more among children.

In the wake of new scientific evidence, let us reflect upon what all we know about the consequences

of extensive firework displays, as it happens on Diwali, New year, or any community related festive occasion, taking into account the meteorological factors prevailing during their celebrations.

- A. Large scale firework displays coincides with the onset of the winter season. From sunset till morning, atmospheric mixing height is low as compared to summer season. In simple terms, whatever pollutants are injected into the lower atmosphere, have less volume to mix in. This results in the further concentrating the air pollutants.
- B. It is already established that the levels of suspended particulate load (SPM), CO, NO_x, Hydrocarbons, SO₂ increase to an unprecedented levels in air. Pregnant women, children and those having a chronic asthma are most vulnerable to the serious medical condition during firework displays.
- C. UV light and ozone exposure make conditions more undesirable.
- D. Meteorological conditions favour calm winds and this will ensure removal of pollutants produced from fireworks hangs in the air for long duration.

One of the most desirable aspect of our life is to have a good quality of life, this requires that we respect the right of every other individual to pursue the same. So, even if we have a great urgent desire to ignite fireworks to seek personal gratification, we should look again, are we not encroaching on the natural rights of others to seek the availability of pollution free air to breathe? Best celebrations are not at the cost of making others unhappy. It is time to seek pollution free air and water and aspire for better quality of life saying no to the fireworks will be a big step towards attaining it.

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November 25, 2001

Dear Eric Bowlby and Joanne Pearson,

I am sending you a report on the articles I have read concerning "firework emissions" particularly the affects they have on health and the environment.

The two factors I found in my reading that affect human health from the emissions from fireworks displays which are particulate matter and ozone formation. Particulate matter and ozone is measured by the AQI which is an index for reporting daily air quality by the EPA for six major air pollutants regulated by the Clean Air Act. The other pollutants are carbon monoxide, lead, nitrogen dioxide and sulfur dioxide. Particles larger than 101 are considered unhealthy for sensitive groups such as active children and adults and people with respiratory diseases such as asthma. Bad ozone is formed in the Earth's lower atmosphere near ground level when pollutants react chemically in the sunlight. Ozone at ground level is a harmful pollutant. (EPA - Office of Air Quality Planning Standards)

I. "Effects of Indoor Fireworks Displays on Air Quality in the Houston Astrodome" Journal of the Air and Waste Management Association, 49, 156-160, 1999 by D.D. Dutcher et al. "Fine and coarse particulate mass samples were collected during baseball games with pyrotechnic displays and control games without displays. The average fine and coarse particulate masses were 173 and 141 micrograms per cubic meter, respectively, for the one-hour period immediately following the pyrotechnic displays. The particulate matter generated by the pyrotechnic displays was composed of the following elements arranged from the most to least abundant: (K, S, Mg, Ti, Cl, Si, Ca, Al, Sr, V, Zn, Mn, and Pb. The fine and coarse particulate fractions had half-lives of 2.0 and 0.9 hours respectively, while the ventilation system operated at a capacity of one air change every three hours."

II. "Formation of Ozone by Fireworks" Nature 411, 1015 (2001) C Macmillan Publishers Ltd. Arun K. Attri et al, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110 067, India 1999 "Ozone is a secondary pollutant and greenhouse gas that is formed from molecular oxygen in the presence of sunlight and nitrogen oxides. The extent of production also depends on the presence of volatile hydrocarbons, carbon monoxide and methanol-6. But we have discovered a surprising source of ozone which is generated in spontaneous bursts even the absence of sunlight and nitrogen oxides- namely, the exuberant mass of colour-emitting sparklers that are lit during the Diwali festivities, which take place every year during October and November in Delhi, India. The underlying process of ozone formation resembles that induced by ultraviolet radiation in the stratosphere. The radiative energy of these emissions is sufficient to dissociate atmospheric molecular oxygen into atomic oxygen, enabling the reaction $O_2 + O \rightarrow O_3$ to take place. This proposed mechanism could explain the formation of bursts of O_3 without the participation of NO_x , and is therefore similar to the process of ultraviolet-radiation-induced formation of O_3 in the stratosphere."

P2. III. "Scientists Say Fireworks Produce Ground-Level Ozone", "Flickering Light Emitted by Sparklers Causes Atmospheric Reaction but Ozone from Cars, Trucks and Buses is Greater Threat" June 27, 2001 by Rick Callahan C MMI The Associated Press." Arun Attri, an associate professor of biophysics at Jawaharlal Nehru University who led the research, said he suspects that all types of fireworks produce some amount ozone."

I have e-mailed professor Arun Attri and am waiting for a reply as to what are his thoughts about fireworks emissions from the Sea World fireworks displays.

In this same article Rick Callahan quotes "air quality experts with the Environmental Protection Agency declined to comment on the study because they had too many questions about the researchers' methodology, said EPA spokesman Dave Ryan.

12/5/2007

"There just wasn't enough information for them to make a judgment on the validity of the study. There's just not enough there," Ryan said. "He said the EPA has no regulations governing fireworks displays, although the Clean Air Act permits state and local governments to enact such restrictions."

IV. "Environmental Affects of Fireworks on Bodies of Water" Thomas A. De Busk et al Rockledge, FL 32956 USA "The effects of fireworks decomposition (FWDP) on the environment are unknown. The infrequency of fireworks displays at most locations, coupled with the wide dispersion of constituents, make detection of FWDP difficult. The present study was conducted to evaluate the impact of repeated fireworks displays on a small lake (WSL). Heavy firework loading has not caused eutrophication or otherwise affected aesthetic characteristics of WSL, but it has added detectable amounts of barium, strontium and antimony to the water and sediments. The mass of antimony and barium in the surface sediments of WS: was found to be Approximately 100X greater than that in the water column, demonstrating that these elements accumulate principally as insoluble compounds."

in water

This publication was sent to me by Jeff Van Deerlan from councilman Byron Wear's office. Who had received it from Councilmember Donna Frye from a City of San Diego Memorandum dated August 16, 2001 from Robert J. Ferrier, Deputy Environmental Services Department Director, titled Fireworks Study.

V. "Effects of Outdoor Pyrotechnic Displays on the Regional Air Quality of Western Washington State" by Kevin D. Perry, meteorology Department, San Jose State University, San Jose, California; Air & Waste Manage. Assoc. 49:146-155, 1999

"Data from a PM 25 particulate matter monitoring network was used to quantify the effects of outdoor pyrotechnic displays on the regional air quality of western Washington State.... In the absence of rain, which is the primary sink for particles of this size, the particulate matter generated by the pyrotechnic displays could have an atmospheric residence time of more than one week." p146 "A total of 34 PM25 particulate matter samplers were deployed in western Washington State from June 1-September 6, 1990." p147 "The size of the particulate matter generated by the pyrotechnic displays is important for several reasons. For example, the size of the particles will determine their atmospheric lifetime and their ability to scatter light and will determine, to a large degree, whether they could pose a potential health hazard." p151..... "Although the plume was tracked for two days and the concentration decreased by a factor of 10 each day, the length of time that these fine aerosol particles would remain in the area and in the atmosphere will depend critically upon the meteorological conditions at the time of the displays.. Under stagnant conditions dominated by high pressure, the particulate matter generated by the pyrotechnic displays could remain in the atmosphere for more than a week. By contrast, high wind speeds and precipitation would quickly disperse and remove the particles from the atmosphere." p152 "While the effects of these displays are relatively small on a regional scale, this data set indicates that the short-term particulate mass concentrations near the source could be extremely high. Although it is possible that individuals with asthma or other pulmonary impairments might be adversely affected if they were to breathe this material, the pyrotechnic devices detonate at altitudes well above the ground and quickly disperse. Thus by the time that the plume impacts the ground, the concentrations should be significantly reduced." p155

VI. For the final report I have a City of San Diego Memorandum from Councilmember Scott Peters and Councilmember Donna Frye to City Manager Michael Uberuaga on the hearing on Sea World dated July 13, 2001 where they ask for "additional information on pollution that may be resulting from Sea World's fireworks displays. Mr. Levinson's testimony at the hearing suggested that even the apparently strenuous efforts made by Sea World to clean up after the fireworks are not entirely successful. In addition, we still do not know the content or the volume of the black residues Mr. Levinson showed us that are apparently reaching Mission Bay. We ask that you determine the nature and extent of the litter and pollution problems and report back to the City Council."

VII. What follows is the City of San Diego Memorandum from Tina P. Christensen, A.I.A., Development Services Director on Sea World, dated August 3, 2001 to Councilmember Scott Peters and Councilmember Donna Frye. Under the heading of "fireworks" it states, "At the request of city staff, Sea World has analyzed the content and amount of fireworks material that potentially may fall into Mission Bay during each typical summer night fireworks show.....Because each star weighs approximately 1.5 grams of material that may fall into Mission Bay." And then under "content" A significant mass of the composition of the fireworks is consumed in the reaction, which creates the fireworks display. However, small amounts of residue and particulates containing some of the metal portions of the fireworks do return to earth. Metals in fireworks displays that generate the coloration comprise less than 2% by weight of the entire mass of the fireworks composition." Then under "environmental effect" heading they state " A study conducted by Disney on the effects of fireworks on water quality concluded that there are no known negative impacts from fireworks materials in bodies of water." This is the study I have under the heading IV.

I did not include all the details of the chemical composition of the fireworks and their oxides but I have that data also if you are interested. I hope this is of some help in our studies on fireworks displays and what effect the Sea World fireworks displays have on our health and the environment. I would very much like to sit down and talk with both of you on this report as soon as possible since there is pressure from Jeff McDonald from the UT as Joanne had mentioned to me. The article in the UT on November 11, 2001 by Steve La Rue is also most interesting especially about the ozone level since the article from India mentions there is a increase of the "bad ozone" from fireworks displays.

I will be available Friday, November 30 th. or December 1 st. So please call me. Of course I would like to be acknowledged for the work I have done gathering all this data for the last several months when and if there is a follow up article in the UT.

If you have any further questions please email me or call me at any time except Thursday, November 29, 2001 when I am having a surgical procedure.

Sincerely, Ariadna R. Wall