

HOW “GREEN” IS YOUR MANUFACTURING PROCESS?

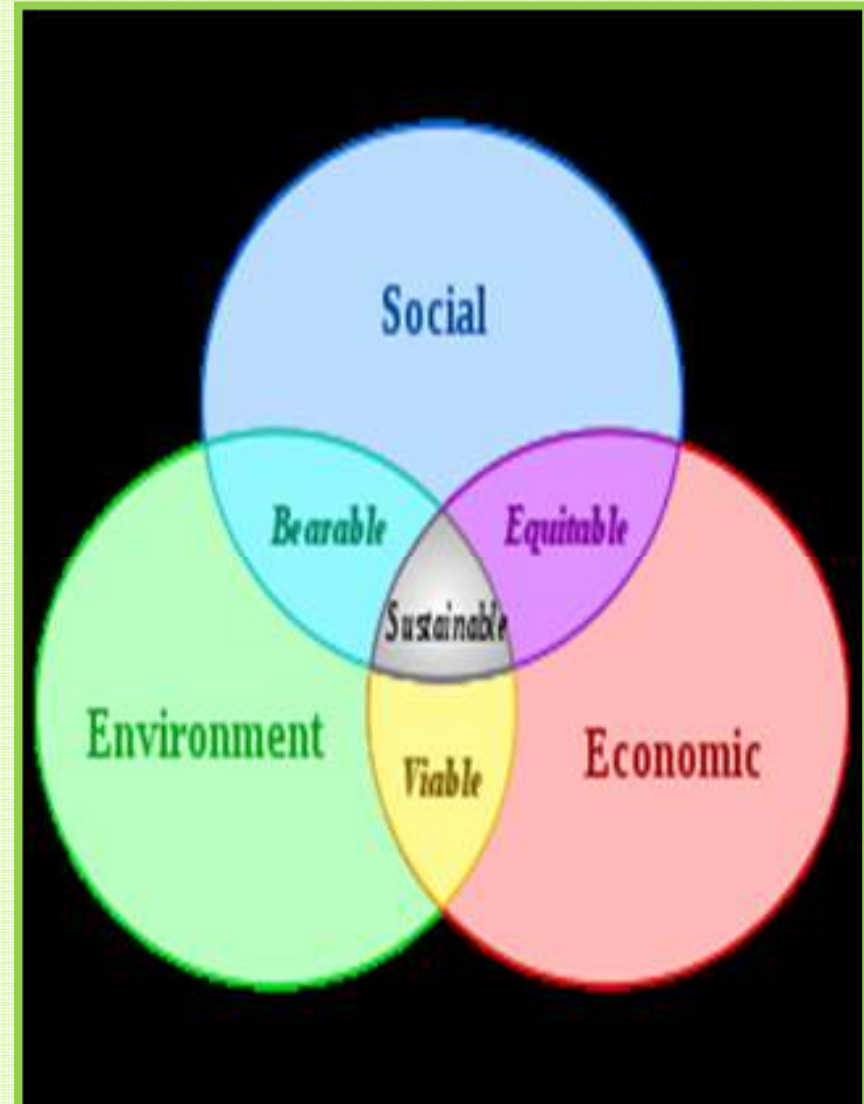
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OUTLINE

Why Green?
Energy Efficiencies
Green Buildings
Green Production
Green Waste

GREEN AND SUSTAINABLE DEVELOPEMENT

- Green manufacturing processes -aim towards lessening the impact on the environment and as an ideal support sustainable development.
- Environmental sustainability processes - ensure that the interaction of current processes with the environment are pursued with the idea of keeping the environment as pristine as possible.



PRINCIPLES OF ENVIRONMENTAL SUSTAINABLE DEVELOPEMENT

Consumption of renewable resources	State of environment	Sustainability
More than nature's ability to replenish	Environmental degradation	Not sustainable
Equal to nature's ability to replenish	Environmental equilibrium	Steady state
Less than nature's ability to replenish	Environmental renewal	Environmentally sustainable

WHY “GREEN”?

Theory

Customers + Competitors exert
pressure + Co. voluntary investment =
Benefits result in >image =
consumers buy products = free up more
resources to develop initial methods=
reducing waste =
saving energy and money.

WHY “GREEN”? CONT.

GHG's

CO₂, NO_x, CH₄, SF₆,
CFC'S and HFC's.

from

Fossil fuel burning
operations such as

Power, cement, steel,
textiles, fertilizers,
EXPLOSIVES and
many others.

- Government Pressure-170 signed the KA (2009- 192)
- KP "caps" or quotas.
- Carbon credits- increasing awareness for controlling emissions.
- United Nations Framework Convention on Climate Change (UNFCCC)- monitoring
- **1992** Earth Summit Rio de Janeiro
- **1995** - COP 1, The Berlin Mandate
- **1997** –COP 3 Kyoto
- **2011** - COP 17 South Africa

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

“Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes. Such policies could include economic instruments, government funding and regulation”

WILLIAM NORDHAUS (YALE UNIVERSITY)

He stated that “....*the price of carbon needs to be high enough to motivate the changes in behavior and changes in economic production systems necessary to effectively limit emissions of greenhouse gases.*”

MOTTAINAI

Mottainai is a Japanese term meaning

“a sense of regret concerning waste when the intrinsic value of an object or resource is not properly utilized.”

And so what does this have to do with us and what can we do about it?

Honesty dictates that all of us should have or have a sense of Mottainai?

A CHANGE IN THINKING ON THE 3R's

- 3R's Reduce, Re-use, Recycle.
- 3R's Rethink, Revise, Restore/Retrofit;
- 3R's for new facilities, Renewable, Rethink, Re-design

This can include;

- Energy efficiency and renewable energy.
- Efficient use of resources -water and power
- use of environmentally friendly building materials
 - Use of green raw materials for
 - Production
 - Waste reduction
 - Toxic substance reduction

WHICH OF THESE HAVE WE CONSIDERED?

AN IDEA FOR RECYCLING!!



RENEWABLE ENERGY

Solar and/or Wind power.



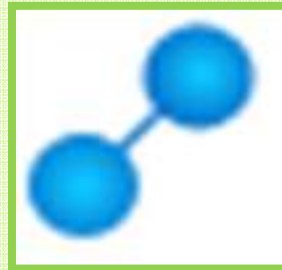
Hydropower



Biomass



Hydrogen & Fuel cells



Ocean energy.

SOLAR PANEL “FARM”



WIND FARM IN OPERATION



SOLAR AND/OR WIND POWER

Generated solar and wind power could be used to supply/supplement power lighting of buildings/ surrounds, sign boards, emergency lighting battery packs, air conditioning etc.

HYDROPOWER

- Little or no reservoir to power the turbines is required
- Small flow (as little as 10l/min) or a drop as low as 0.5m to generate electricity with micro-hydro systems.
- Electricity can be delivered up to 0.6km away.
- Some power companies buy back the electricity
- Maintenance-free water intake equipment and solid-state electrical equipment often make these more reliable.
- Electricity generated can be fed into the “smart grid”.
- Large volumes of H₂O pumped along pipelines can be used for in-line generation systems

OTHER

BIOMASS

- Biomass wastes come in many forms, including "wood waste" (such as shipping pallets and leftover construction wood), biodegradable portion of garbage, gas given off by landfills.
- The burning of waste explosives is a potential source of energy. As they are by and large highly exothermic and "store" huge amounts of energy.

HYDROGEN AND FUEL CELLS OCEAN ENERGY

- These are other ways of generating energy but are probably not appropriate for our industry.

ENERGY EFFICIENCY WATER AND POWER

This is one area where our explosives industry can make a contribution.

- Conventional electricity generation 30 % efficient while with combined heat and power (co-generation) 90% of the fuel can be converted into usable energy.
- >45 % of the fuel used in the US is for steam. One can reduce this energy usage by 20% (according to the US DoE) by effectively insulating steam and condensate return lines, stopping leakages and maintaining steam traps.
- Adjustable speed drives which match motor's energy output with load can effect Energy savings ranging from 3 to 60 %
- Superconducting materials can also reduce energy losses.

POWER CONT.

- New street lighting technologies, such as LED or induction lights have high levels of scotopic lumens allowing street lights with lower wattages and lower photopic lumens to replace existing street lights.

(*Scotopic vision* is the vision of the eye under low light conditions).

- In 2007, the Civil Twilight Collective in the US created a variant of the conventional LED streetlight, namely the Lunar resonant streetlight. These increase or decrease in intensity according to the lunar light thus reducing energy consumption as well as “light pollution”.

ENVIRONMENTALLY FRIENDLY BUILDING MATERIALS

- A building's location and surroundings play a key role in regulating its temperature and illumination. e.g. Trees, landscaping and hills provide shade and block wind. "Sun"-facing windows increase the amount of heat energy entering the building, minimizing energy use, by maximizing passive solar heating.
- US Studies have shown that effective building design, with energy-efficient windows, well-sealed doors and thermal insulation of walls, basement slabs and foundations can reduce heat loss by 25 to 50 %.
- US Studies have also shown that lightly coloured roofs use 40 % less energy for cooling than buildings with darker roofs.
- Proper placement of windows skylights and design can reduce the need for artificial lighting.

BUILDING MATERIALS CONT.

- Compact fluorescent lights use 2/3 energy- last 6-10X longer
- By employing advanced space heating or cooling technology one can save energy e.g. replacing an older 50% efficient natural gas furnace with a new 95% efficient one.
- Heat pumps use 4 x less electrical energy. Reverse in summer.
- Passive Infra Red sensors- can be used to switch-off lighting in unoccupied areas (toilets, passages, office areas after hours).
- Lux levels monitored using daylight sensors can be linked to the building's lighting scheme switch on/off or dim the lighting to pre-defined levels to take into account the natural light and thus reduce consumption.
- Smart meters highlight, for internal monitoring purposes, the building's energy usage in a dynamic presentable format.

SOLAR ROOF INSTALLATION



USE OF GREEN RAW MATERIALS

**Below are a few of many examples
where Green Raw materials can be
used for;**

- **Green Production**
- **Toxic substance reduction**
- **Waste reduction and treatment**
- **Packaging waste reduction**

PRODUCTION

- Key - replacement of existing substances with materials that are more environmentally friendly.

An example of this is replacing Pb in Lead styphnate, azide, nitrate, ethyl hexolate, oxide, stearate, sulphate etc.

- The replacement of an energy hungry product for a less hungry one.
- What are technologists working on to solve the problem?

PRODUCTION CONT

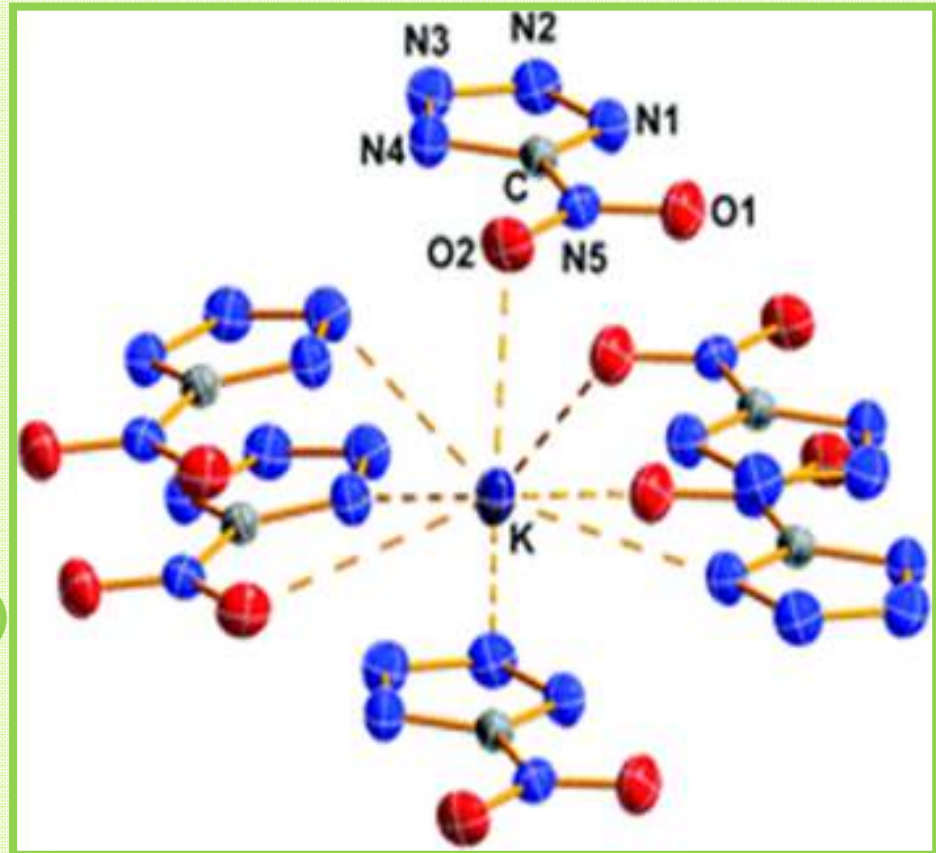
- Thomas Klapötke and his colleagues at the Ludwig-Maximilian University of Munich have synthesized a family of alkali metal salts with the energetic **5 nitrotetrazolate anion** as a replacement for lead azide. (See Reference in paper)
- The salts with Li and Na cations were found to contain crystal water with low sensitivity towards shock and friction.

PRODUCTION CONT

But the alkali metal salts of K^+ , Rb^+ and Cs^+ , form as the anhydrous species and show increased explosive sensitivities . They are most useful as prospective replacements

for commonly used primary explosives.

5-NITROTETRAZOLATE ANION (K)



GREEN PRIMARY COMPOUNDS

In a paper : *Green primaries: Environmentally friendly energetic complexes by My Hang V. Huynh, Michael A. Hiskey, Thomas J. Meyer, and Modi Wetzler*

They report on “four previously undescribed green primary explosives based on complex metal di-anions and environmentally benign cations”.



Where cat is NH_4^+ or Na^+ , M is Fe^{2+} or Cu^{2+} , and NT^- is 5-nitrotetrazolato- N^2).

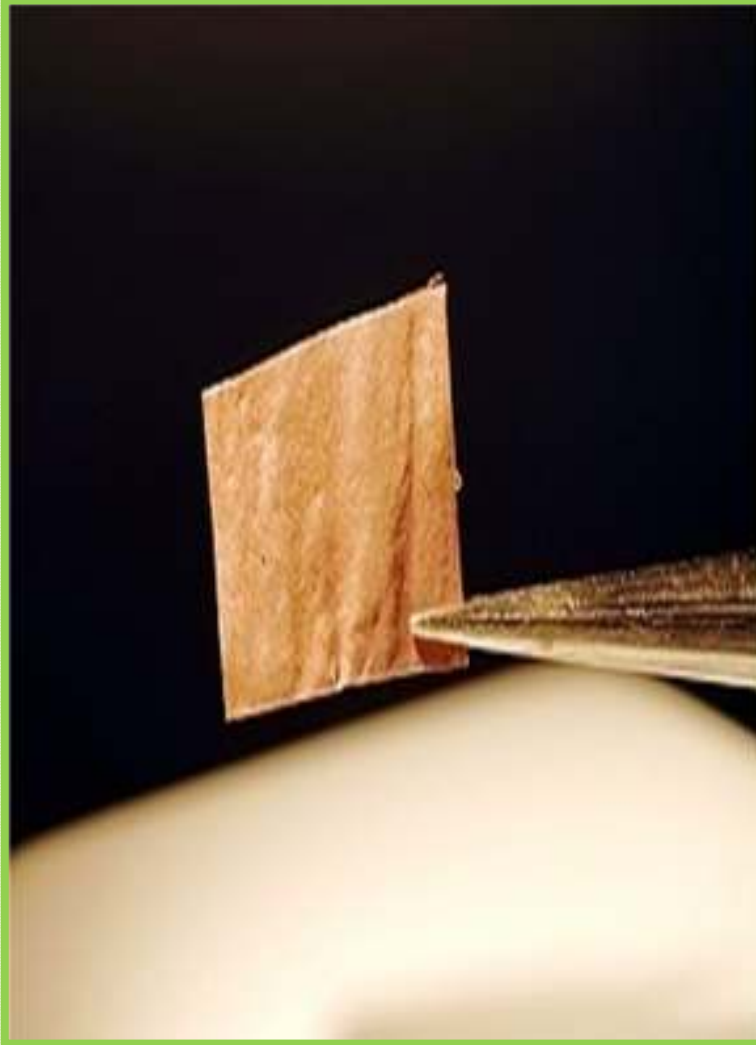
NPED's

Non-primary explosives detonators have of late had a lot of focus.

There are a number of these devices under patent where the thrust has been to get rid of the primary explosives in the detonator.

A team of scientists from the Georgia Technical Research Institute(GTRI) and the Indian Head division of the Naval Surface Warfare Center have developed highly-uniform copper structures, that will be able to be incorporated into integrated circuits and then be chemically converted to millimeter-diameter explosives.

NPED's CONT.



As they can be integrated into standard microelectronics fabrication processes, the copper materials will enable micro-electromechanical systems (MEMS) fuses for military munitions to be mass-produced like computer chips.

Diazodinitrophenol (DDNP)

- Di-azodinitrophenol (DDNP) is used with other materials to form priming mixtures, particularly where a high sensitivities to flame or heat are desired. DDNP is often used as an initiating explosive in propellant primer devices and is a **substitute for lead styphnate** in what are generically termed "non-toxic" (lead free) priming explosive compositions.

(DDNP)CONT.

- DDNP is less sensitive to impact but more powerful than mercury fulminate
- The sensitivity of DDNP to friction is much less than that of mercury fulminate, but it is approximately the same as that of lead azide.
- DDNP may be desensitized by immersing it in water, as it does not react in water at normal temperature. A solution of cold NaOH can be used to destroy it.

A NOVEL ENVIRONMENTALLY FRIENDLY 2,4,6-TNTBASED EXPLOSIVE

**Don S. Nyanhongo, Nina Aichernig, Marcus Ortner, Walter
einer, Georg M. Guebitz**

*Department of Environmental Biotechnology, Graz University of
Technology, Petersgasse 12, A-8010, Graz, Austria*

A novel bioremediation technology was developed that involved the incorporation of a newly isolated *Pseudomonas putida* GG04 and *Bacillus* sp. SF into explosive formulations to enhance biodegradation of TNT residues and other explosives for example if they failed to detonate due to technical problems.

OTHER BIOTECH CONT.

- Biodegradation of Nitro-Substituted Explosives 2,4,6-Trinitrotoluene, Hexahydro-1,3,5-Trinitro-1,3,5-Triazine, and Octahydro-1,3,5,7-Tetranitro-1,3,5-Tetrazocine by a Phytosymbiotic *Methylobacterium* sp. Associated with Poplar Tissues (*Populus deltoides* x *nigra* DN34)

Benoit Van Aken, Jong Moon Yoon, and Jerald L. Schnoor Department of Civil and Environmental Engineering, The University of Iowa, Iowa City, Iowa 52242

- Scientists at the University of York have uncovered the structure of an unusual enzyme which can be used to reverse the contamination of land by explosives.
They have identified bacteria that use RDX as a food source and used that knowledge to develop transgenic plants that can draw pollutants out of the soil and break them down.

OTHER AREAS OF WASTE REDUCTION

- **E-waste**

Quote 2010 National Waste Report Australia

“A relatively small country such as Australia generates more than 100,000 tonnes per year of e-waste in the form of old television sets and computers. This is expected to increase by 80% by 2027-28”.

- **Packaging**

- Starch based plastics
- Polylactic acid
- Poly-3-hydroxybutyrate (PHB)



DO YOU WANT THIS?



How can you live on earth when you treat it like this ?

OR A FACILITY TO BE PROUD OF?



IN CONCLUSION

**WHAT CONTRIBUTION ARE
YOU/WE MAKING?**