PHOTOCATALYTIC DESTRUCTION OF TNT

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What is the advantage of photocatalysis?

- We use a solid-state catalyst that is not consumed in the reaction. We do not need to add chemicals, acids, etc for the reaction. We are water-based.
- Photocatalysis is currently performed at normal ambient temperatures and normal pressures.
- The energy source is sunlight (very inexpensive) or artificial lights and does not require UV lamps, etc.
- Electricity is needed only for pumps, sensors, orientation to the sun unless artificial light is needed.
- Photocatalysis can be done as an on-line process, not a “batch” process.

COMPONENTS OF THE OSU-DAC REACTOR

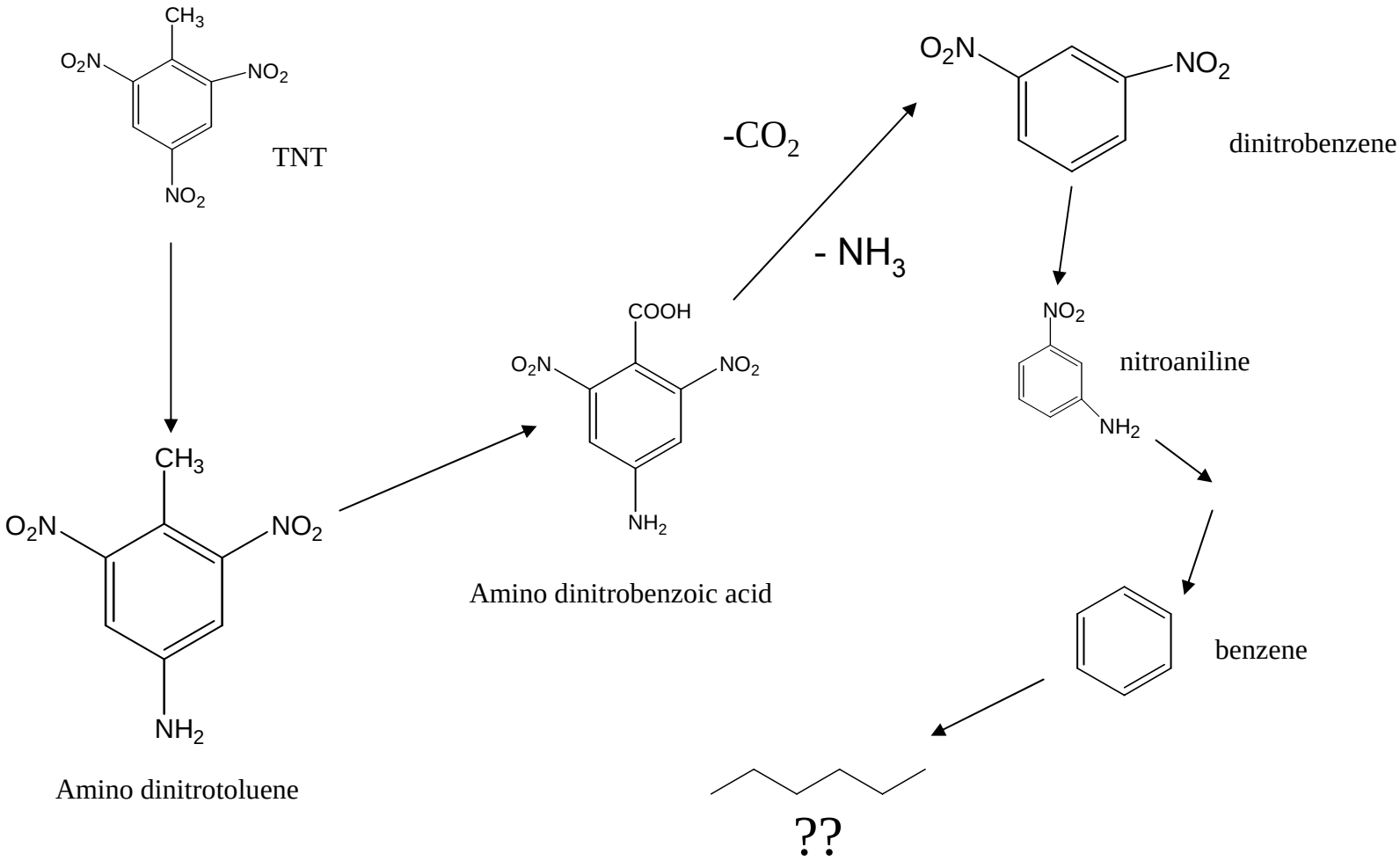
- SOLID-PHASE PHOTOCATALYST IN A TRANSPARENT HOUSING; optimize surface area.

- SOLAR TRACKING PLATFORM to keep the panels oriented to the sun during the day for optimum illumination.

- PUMP to move the material to be treated.

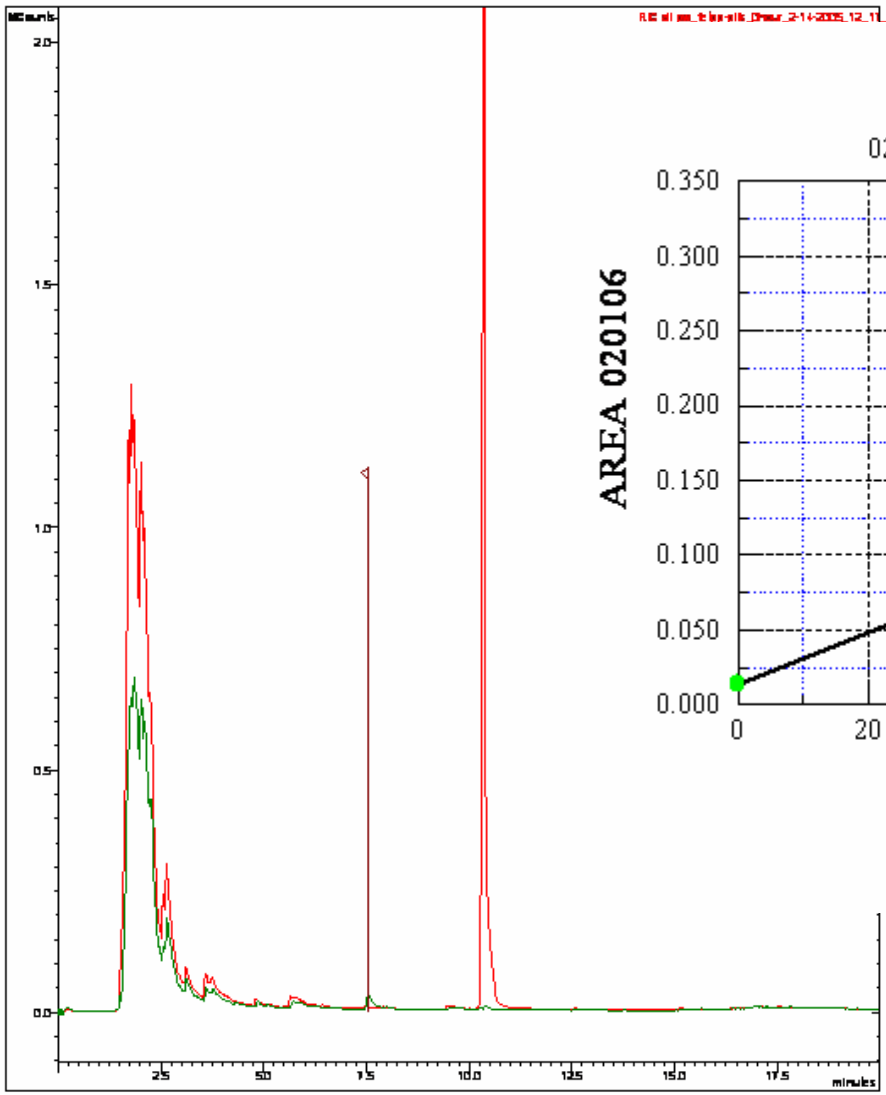
POWER can be provided by batteries or small gas-powered power plant/generator.

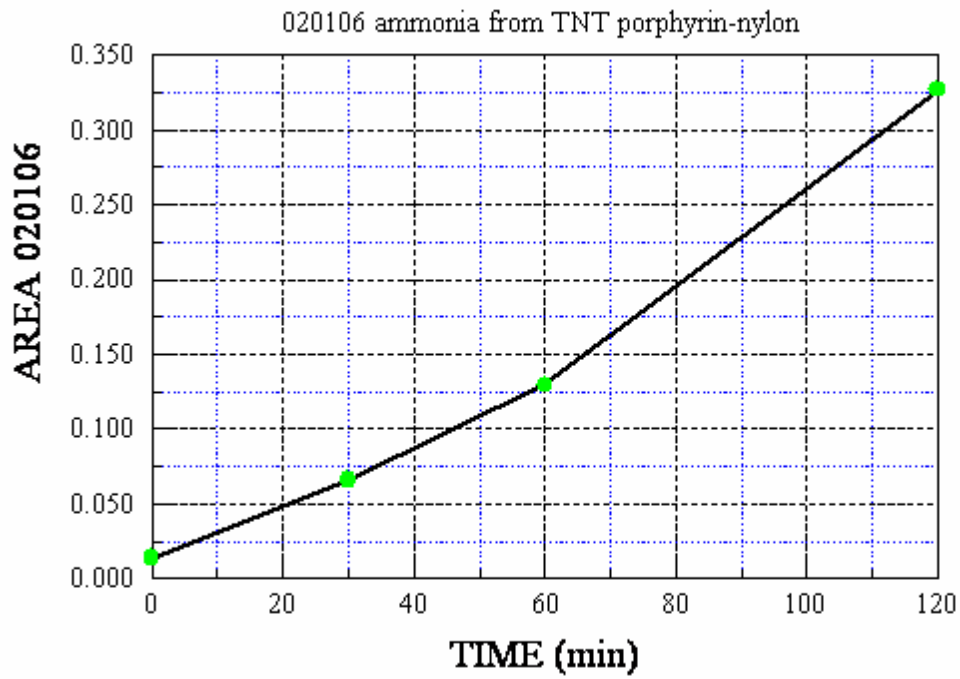
STEPS IN DEGRADATION OF TNT



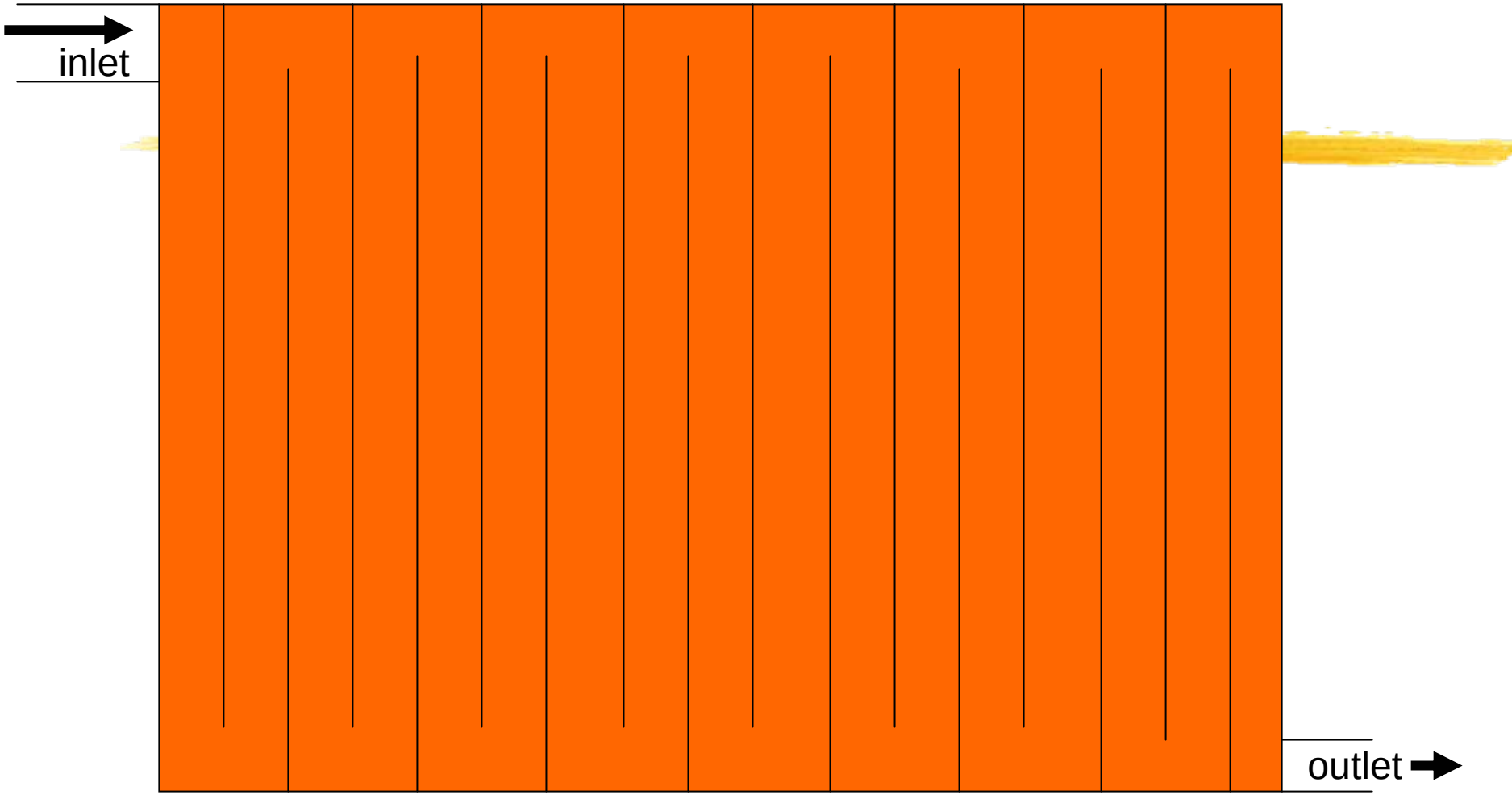
Overlaid Chromatogram Plots

Plot 1: d:\...pm_fetpp-pills_0 hour_2-14-2005_12_17_22.p RIC all
Plot 2: d:\pm_fetpp-pills_1 hour_2-14-2005_1_22_46 pm.ms RIC all

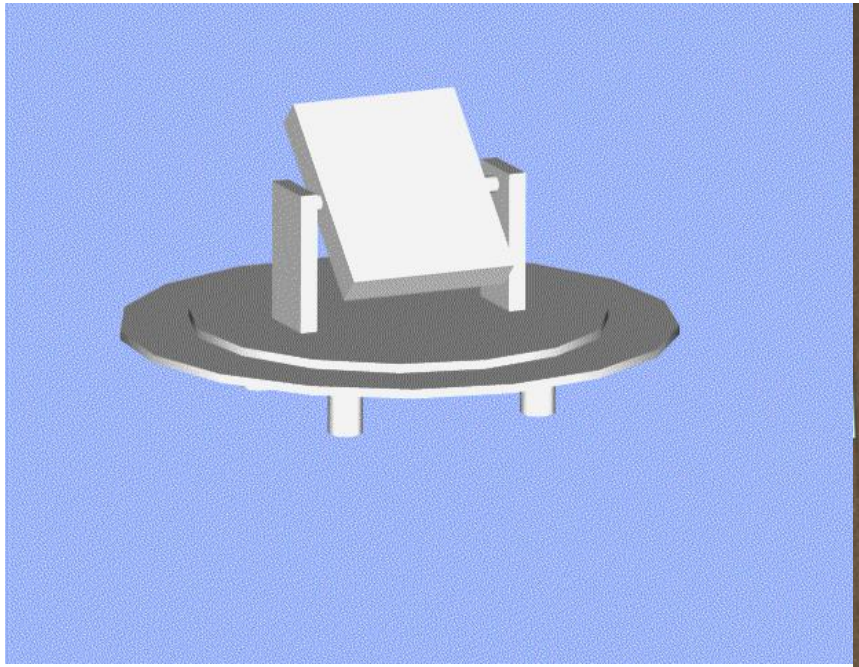




SCHEMATIC DIAGRAM OF THE SOLAR REACTOR PANEL



The overall size will be determined from mass and strength of the reactor panel.



Go visit the prototype at the exhibits!.

HOW MUCH MATERIAL CAN BE HANDLED?

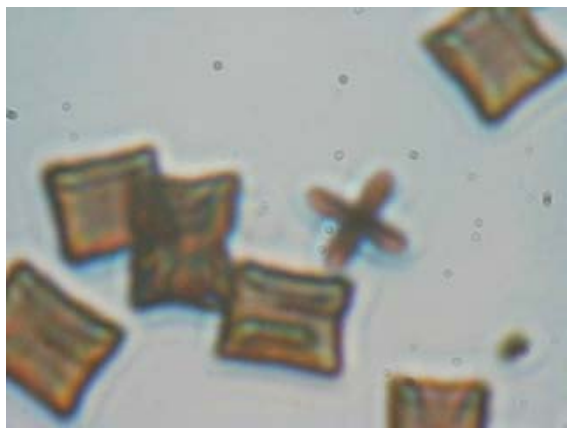
A 10 X 30 ft array of solar reactors will handle about 3,000 gallons of pink water every 12 hrs in full sunlight.

Artificial light is only slightly less effective.

The reaction even occurs on an overcast day, albeit slower.

FIVE PHOTOCATALYTIC SURFACES WITH PORPHYRIN COVALENLTY IMMOBILIZED

1. on fiberglass
2. on artificial man-made fibers
3. on protein base
4. on cellulose
5. nano-tubes and crystals on #1 and 2



COST OF THE CATALYST?

A 10 x 30 ft reactor would have less than

$8,000

of catalyst to treat 3,000 gallons
per 12 hours of sunlight
(OVER A MILLION GALLONS A YEAR)!
(Catalyst is re-useable but not indestructible)

LETS LOOK AT A REACTOR PANEL

- SIZE: 1.2 X 1.2m
- 80 1.2m tubes with 1 cm ID
- 160 connectors
- 6.28 grams of catalyst per tube
- ~1.41 m^2 per tube
- Total surface area per panel: ~112.7 m^2
- Volume of the panel: 6.3 liter
- Total weight of a panel with tubs full of liquid: 29.5 lbs.

What else can be destroyed?

- Benzene and related molecules
- Formaldehyde
- Nitro-energetics including RDX
- Dioxane-based molecules
- Chemical warfare agents and their breakdown products; these are very hard to breakdown normally.
- Pesticides
- The full range of susceptible compounds has not been fully explored!

Key Aspects of this Technology

- Sensors for the analyte to be destroyed; this is not a "cookbook process"; it should be controlled and monitored for maximum efficiency.
- Catalyst
  - Coating the fiber surface with catalyst
  - Packing the glass tubes
- Mechanical supports, motors, trackers
- Control

SENSOR SUITE

The solar reactor is designed to run virtually by itself with as little operator intervention as possible.

The “tracking system” is self-contained and operates without computer intervention.

The solar reactor contains numerous “sensors” to monitor its operation; many are safety-related.

We want to measure as many aspects of this on-line chemical process as we can.

All parameters can be monitored in real time on-site or remotely via computer/internet.

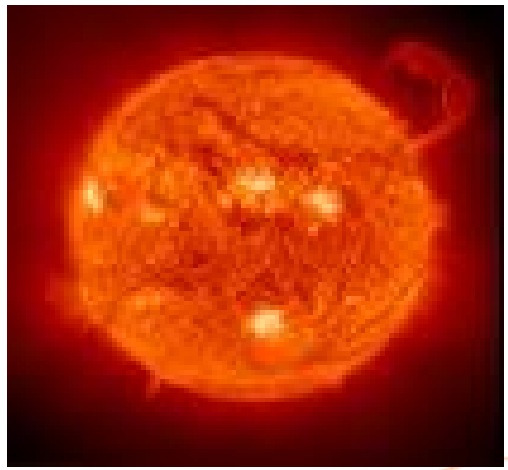
SENSORS

- While tracking is automatic, we want to know if the tracker is operating correctly. We have sensors that tell us the position and direction of the solar array.
- We have incorporated leak detectors that can stop the pumps and shut the system down without computer intervention.
- Temperature probes are mounted at spots along the tubes array.
- The flow of fluid in the array is measured; abnormal flows can trigger automatic shutdown.
- The pH of the incoming fluid is measured.
- The intensity of light is measured.
- The TNT (or whatever analyte) is measured at the beginning of the solar tube array as well as at the end of the array.

COLLABORATORS

Defense Ammunition Center
McAlester, Oklahoma

Here comes the Sun!



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