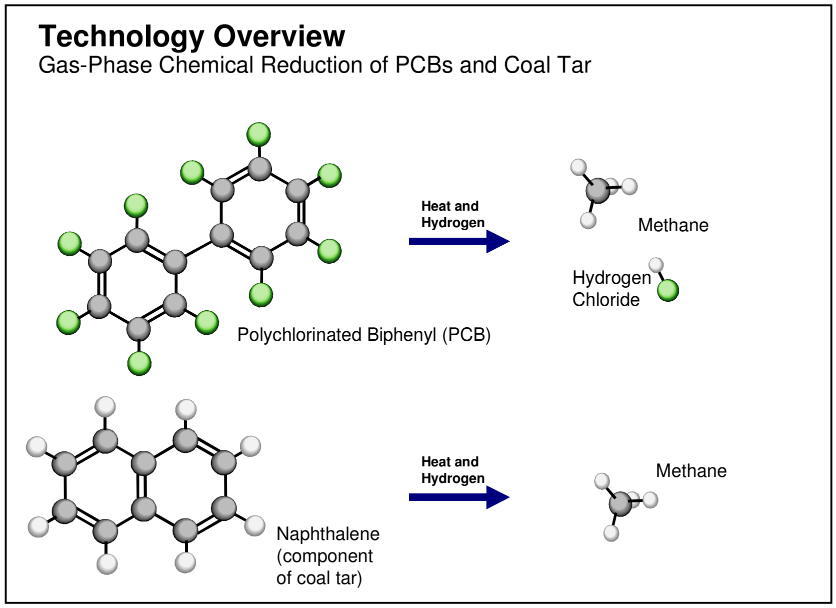
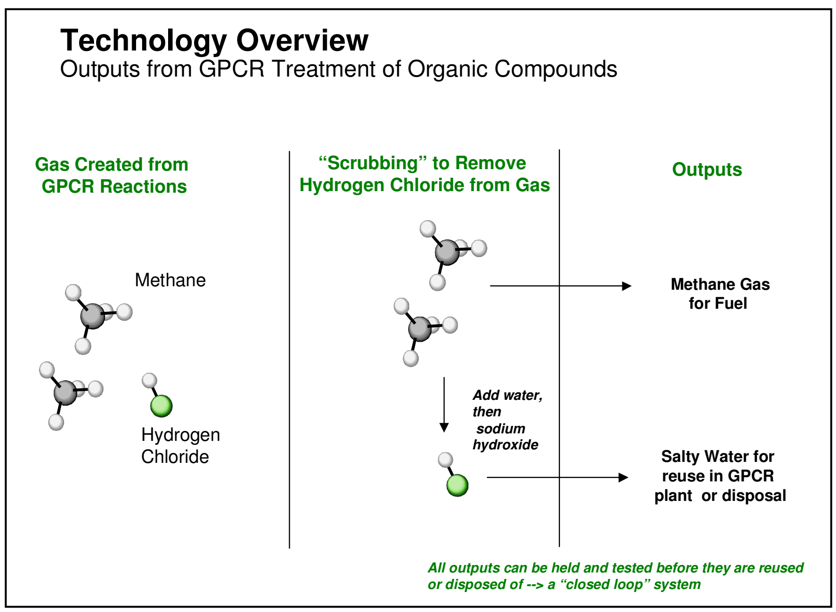
The Role of Gas-Phase Chemical Reduction in the Treatment of Sydney Tar Ponds Sediment

An Overview of the GPCR Technology

GPCR is a non-incineration technology that uses hydrogen to reduce the contaminants down to their basic components. In the case of chlorinated hydrocarbons (such as PCBs), the basic components are methane and hydrochloric acid. Because hydrogen is used, rather than oxygen (as in incineration processes), there is no risk of forming dioxins and furans during the GPCR reactions. Contaminants are conveyed to the GPCR reactor, which has a hydrogen atmosphere, and is heated to a temperature of about 875°C. The combination of heat, hydrogen and steam breaks down the contaminants into *methane* and *hydrochloric acid*.



The *hydrochloric acid* is neutralized with a caustic solution (sodium hydroxide), which creates a slightly salty water. This water is held and tested to ensure it is clean, before it is reused in the plant as cooling water, or disposed of. In the past we've been permitted to dispose of our scrubber water in a variety of ways, including irrigation water at our Australian operation, and to the Welland Canal for our GM project in St. Catharines.



The *methane* is not released to the atmosphere as has been implied by some, but is instead reused as a fuel (methane is the most common component of Natural Gas, which many use as fuel to heat their homes). Some typical uses can include fuel to the thermal desorption device or other system burners, and fuel for a boiler or co-generation plant. Before we use the methane as fuel, however, we make very sure that the gas does not contain any of the original contaminants - this is a clean fuel.

We are aware of a comment made to the effect that our technology simply burns the contaminants that have been taken off the sediments and the soil. We would like to stress that we do NOT burn the contaminants that come off of the sediment. What we burn (as a fuel) is the methane gas that is created once the contaminants have been treated using GPCR, and that has also been tested to ensure it is free of contaminants.

Approach for Contaminated Sediment Treatment

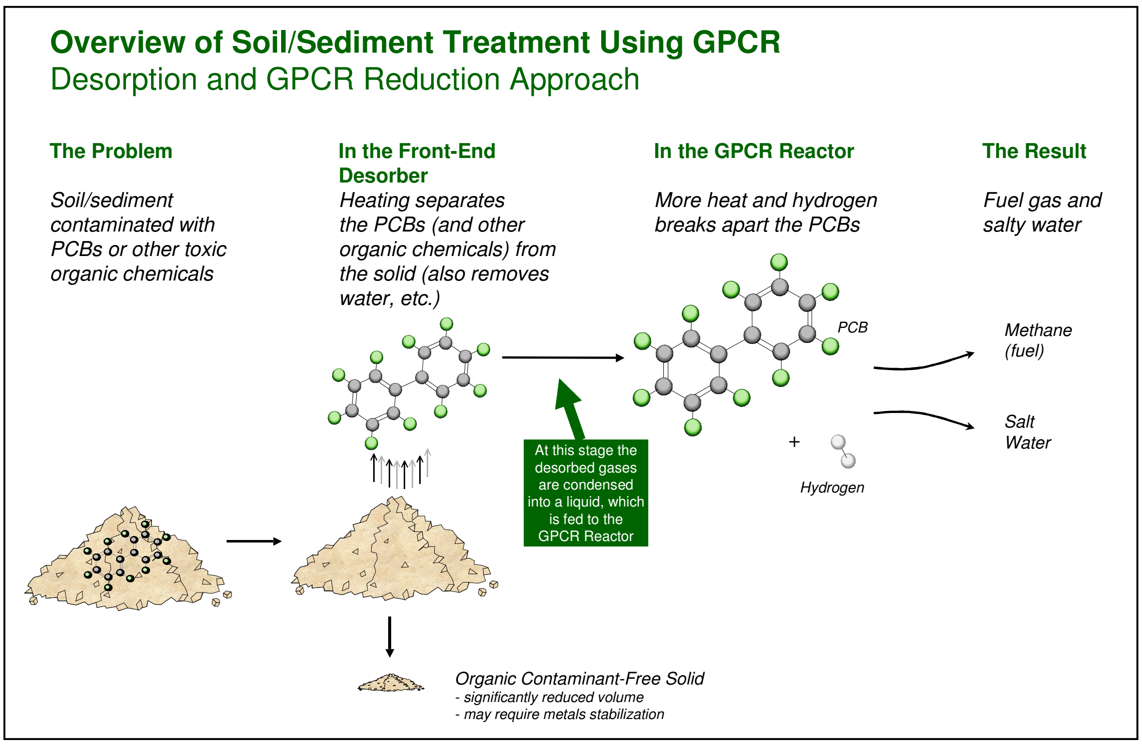
The GPCR reactions themselves are used for the destruction of contaminants (i.e. PCBs, PAHs, etc.). If the contaminants are in a liquid or gaseous form, then they can be heated up and sent to the reactor directly. However, if the contaminants are bound to soil or sediment, as is the case at the Tar Ponds, they must first be taken out of the sediment by some means, before they can be treated in our GPCR reactor. One common way to do this is to use thermal desorption, which heats the soil and "vaporizes" or "volatilizes" the contaminants off of the soil. The gas containing the contaminants can then be captured and cooled, creating a contaminant-concentrated liquid. *It is this liquid that is then treated using GPCR.* We have only preliminary information about the waste at the Tar Ponds site, but have made a rough estimation that of the total quantity of sediment (700,000 tonnes), the amount of concentrated contaminant, once it is separated from the sediment and the water is removed, is in the range of only a few thousand tonnes. These contaminants that have been removed from the sediment using the thermal desorption step are conveyed as a liquid into the GPCR reactor for destruction. Note that we have treated over 3,000 tonnes of hazardous waste, much of which was high-strength concentrated contaminants (PCB oil, pesticide liquids and powders, chemical warfare agents, etc.), and have logged 30,000 operating hours of experience with the technology.

Our approach for treatment of contaminated sediment is a two-stage process:

1) Removal of the contaminants from the sediment using ***Thermal Desorption***

2) Destruction of the removed contaminants using ***GPCR***

In general, another way of looking at our technology is that we are a post-treatment technology to thermal desorption: thermal desorption gets the contaminants off the soil, and then we destroy the concentrated contaminants using GPCR. The "Considering Technologies" fact book covers thermal desorption quite well, and states that the residual material (i.e. the contaminants taken out of the soil) can be treated by a number of other means, including incineration, pyrolysis, and hydrogen reduction (which is GPCR).



The question of the fate of metals present in the contaminated sediment has also arisen. The majority of the metals will stay with the treated sediment in the thermal desorption device. Depending on the concentration of metals in the treated sediment, the material may require some kind of post-treatment step to stabilize the metals. But by this time, there will be significantly less material to deal with, as all of the organics (including organic contaminants) and water will be taken out. It is our understanding that this metals post-treatment requirement is not unique to GPCR or thermal desorption - other technologies (such as incineration) will need to stabilize the metals in the treated sediment in some way too.

On the Question of "Closed Loop"

The GPCR technology has often been referred to as a "closed loop" system. GPCR has three outputs: treated solids (if indeed solids are being treated), water from the scrubbing system, and stack gas from the use of methane gas as fuel. As noted above, the methane gas is only reused as a fuel once it has been monitored and it is confirmed that the gas contains no contaminants. All of this gas is held and tested prior to reuse, and if there are any contaminants of concern in the methane gas, it can be sent back to the GPCR reactor for reprocessing (although this has never been necessary in all our 30,000 plus operating hours). For that matter, all of our other outputs - solids and liquids - are also held and tested prior to reuse. When people refer to our system as "closed loop", this is what they mean - none of the outputs, including the gas we create, exits the system without first being tested. If any of the outputs (including the gas) are found to contain problematic contaminants, they are retreated in the system.

On the Question of Experience

Some of the recent newspaper articles and letters have expressed the need to use only proven technologies, and that Sydney should not be a testing ground for experimental technologies. This is a very wise decision, especially with a project of this magnitude. In that light, we would like to point out that nothing of what is described above - that is, thermal desorption followed by GPCR of the contaminants - is experimental. There are numerous well-proven thermal desorption technologies out there that have done work on large soil and sediment contamination projects. And while Eco Logic has not handled a large soil or sediment project directly, in reality that is not our role at the Tar Ponds. Our role is to take the highly contaminated liquid that is created from a proven thermal desorption technology, and treat it in our GPCR reactor. We did this kind of work for several years in Australia, treating high-strength PCB oil, high-strength hexachlorobenzene, high-strength liquid and solid (powder) pesticides - there is absolutely nothing experimental about the ability of GPCR to treat the concentrated, contaminated residue from Thermal Desorption.

The concern over the "experimental" nature of GPCR may come from our original sediment treatment approach from a few years ago. At the time we were first approached by the project's consultant to conduct bench-scale testing, we had envisioned sending the gases from thermal desorption directly into the GPCR reactor for destruction (i.e. not condensing the gases first and feeding them as a liquid, as we now propose). This "coupled" system was certainly experimental - although both technologies have a wealth of experience doing their particular job (i.e. getting contaminants out of soil, in the case of thermal desorption, and destroying high-strength contaminants in the case of GPCR), we had never coupled the two technologies together. In the past several months we have rethought our approach of coupling the technologies, and realise that an "uncoupled" system, where the two technologies operate separately (although they can be located at the same place if desired), is a much more sensible and economically viable approach. And also, there is no experimental aspect. As mentioned previously, with our new approach there is nothing experimental about using thermal desorption followed by GPCR for treatment of the Sydney Tar Ponds waste. Our approach is to partner with firms that do have experience with large projects such as Sydney Tar Ponds, to offer them our technology for use at the site - we would not undertake a project such as this without strong partnerships with other experienced firms.

Cost and Timeframe

We know that in the past, when we were proposing a "coupled" approach, the timeframe for treating the material was very long. Based on our approach from a few years ago, it would have taken a very long time for GPCR alone to treat the sediment, at a fairly high cost. As it is, with our new approach of separating the front-end thermal desorption device, and using GPCR only to treat the concentrated contaminants, we have reduced both the timeframe and cost.

Note also that different types of waste will sometimes mean different waste treatment costs. For example, when we were treating bulk solid wastes (PCB electrical equipment, transformers, drummed material, etc.) in Australia, our rate was higher because we were treating waste using a specialized front-end device that operated on a batch basis. The requirement for heating the device (to desorb the contaminants), and then cool down following waste processing made for a slower throughput (capacity of about 150 tonnes per month) and higher cost (in the range of a few thousands of dollars per tonne). In the case of soil treatment, however, the economics are very different. Soil or sediment treatment using thermal desorption occurs on a continuous basis, and so the operating costs are significantly lower. Furthermore, feed of the concentrated contaminants to our reactor also occurs on a continuous basis. Both of these factors mean a much-reduced cost for treatment of the sediment or soil.

Typical thermal desorption units can treat from 5 to 15 tonnes per hour. Assuming an average rate of 10 tonnes per hour (roughly 70,000 tonnes per year), this equates to roughly 10 years of desorption (assuming all of the waste is treated using thermal desorption). To halve this timeframe, a second desorption device can be added. Destruction of this condensed material with a small GPCR plant can keep pace with the desorption step. In general, the timeframe offered by Thermal Desorption/GPCR combination is similar to the treatment options recommended by the JAG (per the Halifax Herald article, February 25, 2003), which ranges from 5 to 10 years. Also, we expect the total cost (including both the desorption and GPCR treatment steps) to be similar to the cost range for treatment technologies recommended by JAG. Of course, the cost would have to be reviewed and refined when we receive more information about the precise quantity, contaminant levels, etc.

Summary of the GPCR Technology

- Hydrogen is used to break down bonds in organic contaminants such as coal tar and PCBs
- Outputs are methane gas (which is used as a fuel) and salty water
- Permitted for use in Canada (Ontario), the United States, Japan and Australia; pending in Slovakia
- Over 30,000 operating hours logged
- Rigorous testing and validation for treatment of PCBs, PAHs (coal tar), pesticides, chemical warfare agents, *and many others*
- GPCR has operated at the scale required for treatment of liquids from Thermal Desorption

This document has provided an overview of our approach for using GPCR to treat contaminated materials at the Tar Ponds. We would welcome the opportunity to discuss our approach in more detail, and are always willing to address questions about our technology and its applications from any interested parties. If you would like additional information, please contact:

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