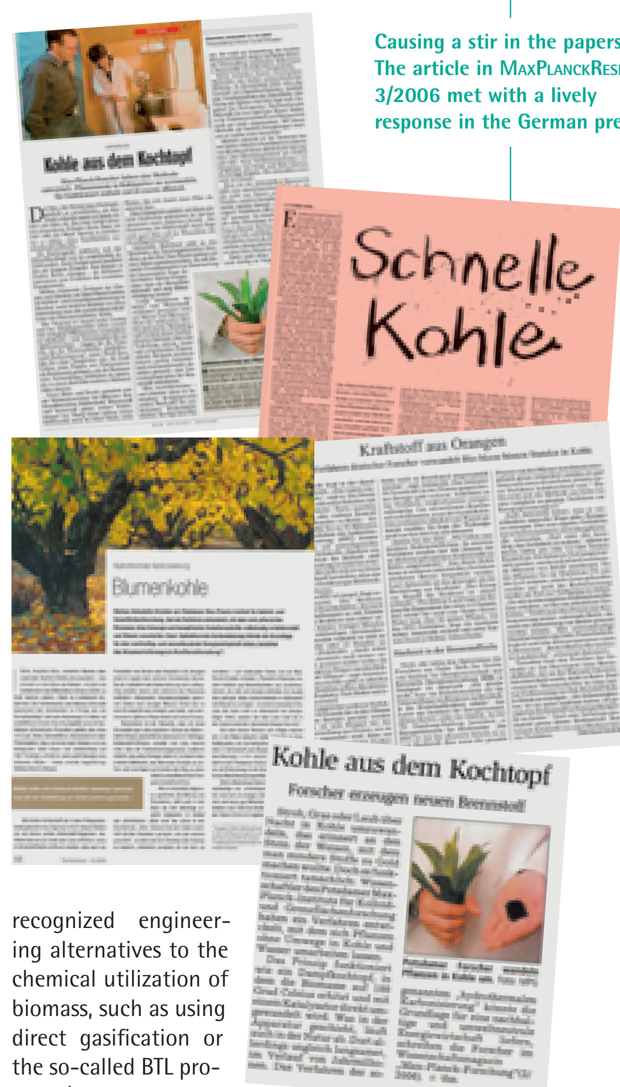
MAX PLANCK News

STRONG RESPONSE TO MPR ARTICLE

Magic Coal – Cooking Again

We have long been delighted to note that science journalists and editors read MAXPLANCKRESEARCH, and subsequently cover some of our pieces. However, seldom has a subject created such a stir as the article on "Magic Coal from the Steam Cooker" in our 3/2006 issue. Big names in the German media world, such as Spiegel, Süddeutsche Zeitung, Geo and ZDF, reported extensively on the work of Markus Antonietti, who converts carbohydrates from biomass waste into coal-like products. Antonietti, Director at the Max Planck Institute of Colloids and Interfaces in Potsdam, Germany, has received almost 1,000 inquiries from all over the world. The e-mails and phone calls are still pouring in, even months after the article was published. The subject is also being taken seriously within the Max Planck Society: an expert commission led by Vice President Kurt Mehlhorn has since been convened to look into hydrothermal carbonization and other potential activities. Here, in view of the considerable interest in his subject, Markus Antonietti answers some of the most frequently asked questions.



Causing a stir in the papers: The article in MAXPLANCKRESEARCH 3/2006 met with a lively response in the German press.

PHOTO: MPS

MAXPLANCKRESEARCH: *Professor Antonietti, is the process of hydrothermal carbonization really something new and unexpected?*

MARKUS ANTONIETTI: No, the carbonization of plant waste is too much of a natural process and very likely a common property for all of mankind. That is why the Max Planck Society has not applied for any patents. Even prehistoric man was able to make birch pitch by carbonizing birch bark. The work being done on the subject today is based on the research of Nobel laureate Friedrich Bergius, who described the hydrothermal treatment of plant materials in 1913. The issue of coal production has been taken up again by increasing numbers of scientists in the past 10 years. These days, there are also numerous established and recognized engineering alternatives to the chemical utilization of biomass, such as using direct gasification or the so-called BTL process (biomass-to-liquid process, *editor's note*). However, these processes are much more technologically sophisticated and can thus be carried out only in a refinery of sorts, and they are not aimed at carbon.

MPR: *What, then, is so special about your process?*
Antonietti: What's special about it is that it goes back to the basics, although it still incorporates modern methods. Hydrothermal carbonization really just means boiling off the water, which makes the process so easy that it can even be done in a non-chemical environment, anywhere, even in the agricultural regions of the Third World. Moreover, hydrothermal carbonization is a sustainable process, and the product – carbon black, a vegetable carbon – has direct value and lends itself well to storage and transportation. Another advantage, although more suitable for high-end applications, is that the form of the coal particles can be influenced in many ways during wet carbonization, a type of polymerization process. For instance, the particles could even become fine, spherical nanoparticles. This creates a completely new range of applications for the coal-like substances.

MPR: *Is the product really coal?*
Antonietti: The product is brown or black, feels exactly like coal and has the same calorific value and many of the same chemical properties as fossilized coal. There are, however, some characteristic differences. For example, the nature of the carbon bonds is more aliphatic and there are only a few aromatic moieties. Furthermore, vegetable carbon is more chemically reactive and has an open, porous structure. If you look at these structures from the perspective of coal as we traditionally know it, you'll find there are aspects that don't fit. For practical application, however, the difference would appear to be less relevant.

MPR: *What is the significance of this vegetable carbon?*
Antonietti: In my opinion, the most significant point is that it provides a simple method of using biomass to convert atmospheric CO_2 into a stable and safe form that can be stored for the short or long term – in other words, a carbon sink. Assuming that technical realization is achieved successfully, this can make a substantial contribution, even to a densely populated and industrialized country like Germany.

A rough estimate for easily accessible biomass waste, excluding wood products, indicates a potential of 50 million tons. That would equate to 25 million tons of bound carbon, or around 10 percent of the carbon currently released through energy production. This alone would allow Germany to exceed its target for carbon reduction under the Kyoto Agreement on Climate Protection with relative ease. From a global perspective, however, the potential is much greater, especially for Second and Third World countries.

MPR: *Is the possible impact on energy supply similarly significant?*

“What's special about it is that it goes back to the basics.” Markus Antonietti, Director at the Max Planck Institute of Colloids and Interfaces in Potsdam, is working on converting carbohydrates from biomass waste into coal-like products.

Photo: Norbert Michalke

Antonietti: No, unfortunately, as the energy density of carbon isn't high enough. Even with tricks like hydrothermal carbonization, as well as other methods developed by engineers across the world, the energy potential currently offered by biomass would cover something on the order of 10 percent of Germany's needs. Other countries, such as Sweden or Denmark, could quite conceivably become fully independent of oil. Furthermore, when used to provide energy, vegetable coal makes no contribution whatsoever to climate protection, so it is probably too valuable a commodity to be burned. But these things will need to be assessed on a case-by-case basis.

MPR: *What are your next steps?*
Antonietti: One of the great advantages of the Max Planck Society is that we have a wide range of expertise available under one roof, and there are many different scientific questions that need to be answered before a technology of this kind can become widely used. Vegetable carbon naturally deserves to be analyzed in great detail in this context, which is something that the Fritz Haber Institute in Berlin is better positioned to do than we are. If the bound carbon were to be considered for use as a means of improving the soil in the natural environment, the lack of biodegradability is obviously something that would need to be quantified. Furthermore, a global approach calls for a global perspective. There are already some very good Earth system models available in the field of geoscientific research that could be expanded to include these kinds of sinks to allow the impact of the CO_2 bound in carbon black to be assessed. So, as you see, there is still a great deal of work to be done.