Fighting climate change and deforestation with green charcoal

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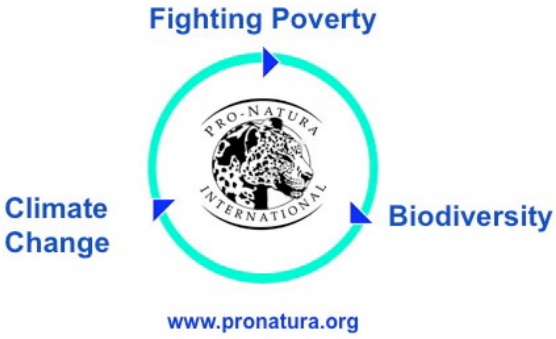

Founded in Brazil in 1986, Pro-Natura was one of the first Non-Governmental Organisations from the South to internationalise: after the Rio Summit in 1992 Pro-Natura International was born, with its headquarters in Paris. More than 400 high-level volunteers are mobilised in programmes in the global South, bringing together the fight against poverty with biodiversity conservation and the mobilisation against climate change.

Two billion people must face the problem of domestic energy needs that pushes them to deforestation, adding to the problems of drought and desertification. To fight this, Pro-Natura invented and developed the innovative technology of "green charcoal". This technology proves to be very competitive in relation to wood charcoal, has a positive effect in terms of climate change and in recognition of this, received the 1st place prize for technological innovation from the Altran Foundation in 2002.

The access to energy, which is increasingly considered a fundamental right, is a necessary condition for all processes of development. In Africa, Latin America and Asia - including India and China - wood is becoming harder to find and in general alternative energies do not exist. Two billion people across the world therefore depend on wood generating deforestation for their domestic energy needs - particularly in Africa, where it represents 89% of energy sources. This use of unsustainable wood is a major cause of deforestation, which poses a serious ecological risk. Deforestation accentuates drought, desertification and climate change.

The exclusive use of wood as a domestic fuel presents numerous other major disadvantages:

- As deforestation progresses, the burden on women and children mounts: they must travel longer and longer distances to supply themselves with the wood and other forest products they need. This additional obligation diminishes the time they could dedicate to other tasks, which are nonetheless indispensable. In the Sahel for example, women must at times travel 20 kilometres a day to find the wood necessary to cook their food;
- With less fuel available, the quantity and quality of food diminish;
- Supplying the necessary fuel energy demands an increasingly large proportion of revenues;
- Finally, smoke released is harmful to the eyes and lungs, the WHO estimates that 1.6 million women and children die prematurely because of wood smoke in poorly ventilated homes.

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Taken together, the serious constraints of wood use by these populations reduce the possibilities for improving their living conditions and impede economic progress.

Pro-Natura won in 2002 the 1st prize for technological innovation from the ALTRAN Foundation for having found a solution to this problem.

The solution consists in recuperating agricultural residues or renewable biomass that cannot be otherwise valorised and transforming them into briquettes of green charcoal that can be used in the same way as wood charcoal. With this procedure, Pro-Natura proposes a domestic fuel made of vegetable charcoal, obtained with a carbonisation process, the effectiveness of which has been proved.

This process is based on the continuous carbonisation of renewable biomass. Savannah weeds, reeds, straw of wheat or rice, cotton and corn stems, rice or coffee husk and bamboo can all be used to produce green charcoal. Wood can also be carbonised in any shape, even as sawdust with a yield around 3 times higher than using classical batch processes.

Each Pyro-7 machine allows the economical and ecological production of between 4 and 5 tons of green charcoal per day.

The first machine made in France has been in use in Senegal in the Saint-Louis region since the end of 2007 (see photo above). In partnership with Areva, the technology was transferred to South Africa to the Necsa Company who has a production license for the southern cone of Africa.

The carbonisation of biomass is made in a continuous manner.

The process is based on the continuous carbonisation of vegetable matter, by agglomerating the charcoal thus obtained into nuts, briquettes or bars. The trials previously done to carbonise the biomass in a batch process by entire sheaves failed due to mechanical problems and poor energy efficiency.

This technology is based on the use of a retort heated to 550°C in which the biomass flows continuously, in the absence of oxygen. The temperature of the retort is maintained constant with the combustion of the pyrolysis gases that are recycled and burned in a second post-combustion chamber.

One of the originalities of the process is that once the machine is preheated, the process produces its own energy, except for the transfer of the biomass, which is done with a small low-energy consumption electric motor.

This process is therefore practically autonomous in terms of energy and its yield (weight in green charcoal in relation to weight of the biomass at 15% moisture) reaches 30-45% according to the type of biomass.

Potential in the fight against climate change

The reactor functions without any greenhouse gas emissions other than CO_2 recycled in the process of regeneration of the renewable biomass.

While remaining comparable to traditional wood charcoal in terms of caloric power, green charcoal presents the following advantages:

- Avoids the pressure on forests through the substitution of other renewable forms of biomass in place of wood;
- Improves the yield of carbonisation (30-45%) compared to traditional production methods (around 10%);
- Eliminate the CH_4 emissions of traditional carbonisation.

- Compared to the base scenario, green charcoal technology leads to a reduction in greenhouse gases in the following domains:
- Prevention of deforestation that would have resulted from the production of wood charcoal;
- Emissions of CH_4 from traditional wood charcoal production prevented;
- Reductions of CO_2, CH_4 and N_2O emissions from the lack of combustion of agricultural residues.

- Estimation of emission reductions is based on the following hypotheses:
- Deforestation prevented per ton of wood charcoal not made: 5.5 tons of dry wood, corresponding to a conservative number chosen by the Carbon Fund of the World Bank;
- Emissions of CH_4 prevented per ton of wood charcoal not produced: 3.5 t CO_2 - equivalent. This value is an average between the emissions of the least sophisticated traditional carbonisation techniques of the Sahel (which are common in the base scenario) and the value used for the Plantar project, in which sophisticated ovens are used;
- Brush burning of unused biomass avoided: permits reduction of 0.06 kg of CO_2-equivalent per ton of biomass used in the production of green charcoal.

To date, there is no CDM Methodology approved by the UNFCCC. However, Pro-Natura proposes to develop a new methodology that would render the project eligible as a small-scale operation.
Pro-Natura already follows the prescriptions of Annex B relative to the simplified procedural modalities of small-scale CDM projects. Specifically, it conforms to Paragraph 19: “For renewable energy technologies that are replacing sources of non renewable biomass, the simplified baseline is the consumption of sources of non renewable biomass multiplied by an emission ration corresponding to the sources of non renewable biomass replaced”.
The calculation evaluating carbon credits generated by one Pyro-7 machine result in: 11.6 tons of CO_2-equivalent per ton of green charcoal.
We are pleased to announce that Air France, through the intermediary Action Carbone of GoodPlanet, is now giving its passengers the option to compensate their CO_2 emissions with carbon credits generated primarily by the Pro-Natura green charcoal project in Senegal. See: www.actioncarbone.org

Choice of mode of carbonisation in a retort and the advantage of this technology

It was very easy to direct our choice of carbonisation to carbonisation in a retort. The principal reasons are the following:

- The valorisation of all types of woody vegetable matter with non-negligible calorific potential, thus a biomass that can be of low particle size;
- An improved yield of production (biomass/charcoal);
- An improved energy yield thanks to the recuperation of the pyrolysis gases.

The technology developed by Pro-Natura is based on the use of one or several retorts heated to 550°C through which the biomass flows on a continuous basis. The temperature is maintained constant by the combustion of the pyrolysis gases that are recycled and burnt in a post-combustion chamber.

In addition to the advantages of the carbonisation process in the retort, the cost of running the reactor is lowered by the continuous production, thus avoiding stopping the machine each time to recuperate the charcoal. This process also allows the obtaining of an optimum energetic yield, concerning the carbonisation in the retort, thanks to the excellent mastering of the combustion of the pyrolysis gases assuring the self-sufficiency of the reactor's functioning.

The complete combustion of the pyrolysis gases with this technology allows not only to permanently maintain a carbonisation temperature around 550°C for a biomass of a maximum of 15% humidity, but also to allow for a decanting of heat serving to either:

- Preheat a second reactor and heat a dryer; or
- Produce an overheated vapour allowing the running of a turbine and thus an alternator to produce electricity.

Agglomeration of these vegetable charcoal smalls

After carbonisation, an agglomeration of these charcoal fines is necessary to facilitate the combustion and transport of the briquettes obtained.
These agglomeration techniques are in two main families: compression techniques and pelletisation (a non-compressing technique).
The fabrication of briquettes or charcoal nuts demands a binder to mix with the charcoal fines. This binder can either be starch, Arabic gum, molasses or clay. The percentage varies from 10 to 20% in the case of clay.
The wet briquettes next pass into a dryer to eliminate the water, in such a way that they are sufficiently solid to be used in domestic ovens and cooking devices.

Application of green charcoal to the increase of agricultural productivity

The fertilisation of the soil by green charcoal is an ancestral practice initiated more than 7000 years ago by pre-Columbian Indians in the Amazonian regions. According to the most recent studies, these enrichments applied by the Indians on their fields consisted principally in a mixture of carbonised matters (such as wood charcoal, called biochar in this context) and organic waste, which led to the formation of a particular soil of a deep colour and of remarkable fertility, the "Terra Preta".

These properties were conserved until today and discovered recently by the scientific community, which accords it an increasing interest. Recent research thus showed that the great fertility of the Terra Preta results principally from the presence of numerous carbonised particles that act as a “nest” facilitating the fixation of water and nutrients and the development of a rich population of microorganisms in the soil responsible for the improved growth and resistance of the plants that grow there.
This also explains why optimal fertility is in fact obtained in combining enrichment by biochar (at around 15 tons/hectare) with a complementary traditional fertilisation (compost, manure…) bringing the essential microelements to “nest” here.

If the exact duration of retention of the carbon by the Terra Preta still remains clouded in mystery, the soils discovered prove that this longevity can easily reach several thousands of years, which permit us to consider this a real “carbon sinks” capable of offering an effective, clean and sustainable solution to the problems of climate change by absorbing and stocking the excess CO_2 from the atmosphere as carbon.

Faced with this fact and the results of numerous conclusive tests on biochar conducted in the last years around the world, Pro-Natura decided to encourage the use of its green charcoal as a biochar and launched pilot projects on several intervention sites. The environmental benefits of this innovative application add to the advantages already recognised of the substitution of green charcoal for wood charcoal (deforestation avoided, no methane emissions, etc.). It is thus possible to render the carbon footprint globally negative (by taking more carbon from the atmosphere than is emitted), while fighting effectively against poverty and hunger by the sustainable and lower cost increase of productivity of the land and the reduction of the dependence on traditional, expensive and polluting fertilisers.

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