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What is biochar ?

BIOCHAR MATERIAL is:

- Plant and/or animal bone biomass origin,
- stable carboniferous material,
- Used for mandatory EU/MS Authority permitted ecological soil enhancement, and eco-safe carbon negative applications.

BIOCHAR PRODUCT is:

- A labelled and full value chain soil functional safe product,
- Pyrolysis processed and having extended producer responsibility product guarantees,
- **Meets all the EU/MS product criteria for production and Authority product permits. REACH registered.**



There is no one fit for all biochar solution and/or product. However, in all biochar cases above 1 ton/year capacities in the EU, the biochar must meet high safety standards, Extended Producer Responsibility and all the mandatory EU/MS/REACH permits for biochar production, product quality, agricultural applications and placing on the market.

The input feed material characteristics of the biochar production are usually reflected into the output product characteristics; however in all cases the sustainable biochar feed materials does not compete with human food, animal feed and plant nutrition supply. Biochar is produced from various types of biomass by-products and in some cases from Waste Framework

Directive EoW "End of Waste" criteria waste-to-products converted organic products as well. **All types of biochar products made for soil/plant management functionality only**, either by direct applications, and/or indirectly together with compost and/or by other plant growing means. Biochar applications are usually irrevocably that scenario is putting strong technical, economical and legal responsibility for the producer.

The biochar processing technology design and performance is the key factor for the ability to produce safe and quality biochar. All in order to achieve safe and high quality biochar, that is a chemically modified substance, as of EU standards, usually at least >450°C reductive thermal processing material core temperature required for plant biochar and at least >650°C up to <850°C reductive thermal processing material core temperature required for ABC Animal Bone bioChar.

The pyrolysis also results in gas and oil products (pyrolysis oils or bio-oils), that after refining useable for energy production or chemical industry feed.

REFERTIL PARTNERS





The nutrient recycling via biochar substance

The nutrient recycling via biochar substance is practically considered when the nutrient density is reaching economically interesting scale and/or improving nutrition efficiency in any one or several of the product function categories and meet the requirements for the relevant component material category as of COM (2016) 157. In this context the major biochar aspects are the nutrient density; nutrient solubility and plant availability; functional driven product quality and safety; economy and legal compliance. The key biochar objectives are the contribution to circular economy objectives, increasing resource efficiency and decreasing import dependency for raw materials essential to European agriculture, in particular Phosphorus for the purpose of providing plants with nutrient or improving their nutrition efficiency.

Conversion of plant and animal bone to biochar provides new strategies for application of soil improvers and organic Phosphorus fertilizers. Plant based biochar (PBC) is characterized by high carbon content but no direct fertilizer effect with economical importance, therefore the PBC product functionality is soil improver or growing media, with usual doses between 5 t/ha to 20 t/ha. In some cases plant or waste derived biochar having high ash content from uncontrolled burn off, but in that case the substance may come under ash component material category.

ABC is a recovered organic P-fertiliser

Animal Bone bioChar "ABC" is a recovered organic P-fertiliser, made from animal bone grist, having high nutrient density (30% P₂O₅) and pure P-content.

The rendering industrial origin food grade category animal bone grist processed ABC Animal Bone bioChar is a nutrient dense (30% P₂O₅) organic fertilizer with as high as 92% pure calcium phosphate and 8% carbon content only.

Therefore the ABC product functionality is fertilizer, soil improver, growing medium and/or fertilising product blend, with usual doses between 100 kg/ha to 600 kg/ha.



THE PHOSPHORUS IMPORT SUBSTITUTION POTENTIAL OF ABC

According to the EFPRA (European Fat Processor and Renderers Association) 328 million pigs, sheep, goats, beef and dairy cattle are slaughtered in the EU each year together with 6 billion poultries. 34% (pig) -42% (cattle, beef) of the animal is rendered. According to Eurostat 45.8 million tons live weight animals slaughtered in the EU in 2015 (Eurostat 2016).

The European rendering industry (35 EFPRA members, 26 EU countries) processed more than 17 million raw materials in 2014 (EFPRA, 2015), from which the category 3 processed products are 12 million t/y. EFPRA members processing the majority of the total animal by-products in the EU and additionally significant amount of material streams produced by non-member organizations. The skeletal system can be up to 20 percent of the carcass weight, which mean that over 4 million tons of animal bone biomass produced in the EU annually. After rendering industrial processing at 133°C 20 min 3 bars the different types of rendering product outputs are 2.7 million t/y animal fat, 3.9 million t/y animal proteins, 825,000 t/y fertilizer and other products, liquid fuel, oleochemicals and animal bone products.

The Eurostat is indicating that the estimated consumption of manufactured Phosphorus fertilisers in EU 27 (2014) was 1.11 million tons based on data provided by Fertiliser Europe. This is equivalent with 2,55 million to mineral P fertiliser expressed in P₂O₅. Around 90% of the phosphate rock used to produce fertilisers is imported.

Significant part substitution of phosphate import by recovered Phosphorus would be important goal for the European agriculture already in short term. **The imported mineral Phosphorus agri substitution potential by bio ABC in European dimension is 3% (75,000 t/y P₂O₅) in short term <2025 and up to 20% in long term >2025.**





What are the key differences between slaughterhouse output crude animal by-products and it's derived products from rendering industries?

The outputs of the slaughterhouses are farmed animal products for human consumption and crude animal by-products that are further processed in other industries, such as fat processing and rendering industries to make new and safely derived products. **All slaughterhouse crude ABPs must be processed**, that is resulting derived products in the rendering industry. Slaughterhouses do not process animal by-products but deliver such materials to other and specialized industries, specialized for fat processing and rendering operations only at the usual processing condition 133°C.

The direct agricultural use of the crude protein content animal rendering products provides high environmental risk by possible trans and recontamination by human and animal pathogens. Despite animal rendering by-products (protein based bone meal and MBM) are sterile products at the point of production, there is a very high risk for cross and recontamination during applications. While rendered products leave the cooker negative of the bacteria, recontamination can occur anywhere along the way. **Not all animal by-products are suitable for production of high quality recovered Phosphorus fertiliser.**

What is MBM – Meat and Bone Meal?

MBM - meat and bone meal mix is made by "rendering" of categories 1 and 2 ABP materials by processing at **133°C at 2 bars pressure for at least 20 minutes**, to ensure partial sanitization (this is considered to be sufficient to eliminate bacteria and viruses but not prions, which prion elimination require processing temperature treatment over 500°C). The rendered product typically contains about 48–52% high protein content, 33–35% ash, 8–12% fat, and 7–10% moisture. The MBM rendering process produces energy or the products are taken in energy-production installations authorized to take these categories of Animal By Products for energy conversion. Meat and Bone Meal Ash is produced by high temperature incineration/calcination treatment of MBM in a heat process conform to the Industrial Emissions Directive (2010/75/EU Incineration Directive) Article 6 = conditions of incineration at minimum 850°C for at least 2 seconds, TOC (total organic carbon) in ash powder <3%. These conditions ensure complete elimination of all pathogens. MBM is used for energy.

What is PAP - Processed Animal Protein?

PAP - Processed Animal Protein is made only from **non ruminant** (pigs, chicken, horses, fish) origin and Category 3 food grade animal by-products, with high protein content by processing under the same conditions as MBM (see above). The broad variety of PAPs including blood meal (90-95% proteins), poultry (65-68% proteins), feathers (80-85% proteins), pork products (55-65% proteins) and fishmeal. PAP is used for high protein content pet food and fish feed.

What is Bone Meal?

Bone Meal is made from selected Category 3 food grade animal bones only, collected in separate industries and processed separately, with processing under the same conditions as above (this is therefore distinct from MBM or PAP). It contains typically about 30–38% protein content, 50–62% mineral, 5–8% fat, and 7–10% moisture. Bone Meal is used for production and extraction of gelatine for the human food industry; China bone (burned bone ash powder for porcelain industry); pet food and **ABC Animal Bone bioChar production** (e.g. REFERTIL / 3R Zero Emission Pyrolysis technology). This type of granular and 1-5 mm sized biochar product with 30% P₂O₅ high nutrient density is made of food grade animal bones and can be used as full value organic fertiliser or as an adsorbent.



3R Technology / REFERTIL is a zero emission pyrolysis, reductive thermal processing (<850 °C) with 2000 t/y throughput small industrial demonstration capacity which system is operating since 2004. The ABC Animal Bone bioChar Phosphorus recovery EU wide applied research and industrial engineering project foregrounds is since 2002; legally Authority permitted under EU/MS regulations and in 7 countries long run field tested including its formulated BIO-NPK products.

The 14 years Animal Bone bioChar S&T research results are under 2016/2017 replication/implementation to 20,800 t/y throughput capacity.





"3R" zero emission carbon refinery technology application map for flexible reductive thermal processing in any range up to 850°C material core temperature.

**High temperature reductive thermal processing 450°C - 850°C .
Pyrolysis - Carbonization**

**Activated Carbon
ADSORBENTS
Virgin & Regeneration**

**Bio-Phosphate
recovery ABC
Animal Bone bioChar**

**High C content
BIOCHAR
Plant bioChar**



www.3Ragrocarbon.com



NOTICE:
From technical point of view there are many more application areas, that can be considered case by case.

**Torrefaction
BIO-ENERGY
Torrified Biomass**

**Browncoal processing
CLEAN COAL
Clean Solid Fuels**

**Thermal Desorption
CLEAN SOIL
Soil Remediation**

**Low temperature reductive thermal processing 150°C - 450°C .
Torrefaction - Thermal Desorption**

REFERTIL BIOCHAR in economically interesting scale and European dimension. After successfully completing the REFERTIL applied S&T research project by the end of 2015, as exploitation of the results several full scale 3R BIOCHAR industrial projects are under commercial organization in the EU, Australia and US in 2016/2017.

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