



## The BioPhosphate development history

[biochar@3Ragrocarbon.com](mailto:biochar@3Ragrocarbon.com) <https://biophosphate.net> <https://biophosphate.net/video>

3R-Biofarm Upcycling centre: <https://3rbiofarm.com>

Author: Edward Someus

### The BioPhosphate history:

On the Planet Earth naturally high concentrated Phosphorus can only be found in one unique mineral and that is the apatite, which has two natural forms:

- 1) **MINED MINERAL APATITE** is mineral phosphate rock, which is a non-renewable (formed over millions of years) critical raw material and naturally **containing high levels of “Cd” Cadmium, “U” Uranium and other potentially toxic elements**. Phosphate rock is important global source for enriched Uranium to supply nuclear power fuel. Cd and U are always associated in mined phosphates, which means if Cd is high than U content is also high. Today the mined phosphate rock is also the main significant commercial source of phosphorus used to manufacture chemosynthetic fertiliser and phosphoric acids. However, all forms of mined phosphates naturally containing high levels of Cd and U.
  - a. **The mined phosphate is not renewable** and it's processing is high energy demanding, consuming large amount of sweet water, generating large amounts of toxic waste streams while having significant negative environmental and climate impacts. Today, significant part of the World Uranium fuels for nuclear power use is extracted from mined phosphates.
  - a. The process to convert the ore into a **rapid release phosphorus mineral fertiliser product** is done by chemical extraction with an acid. In this context, the nutrient use efficiency of the mineral phosphate fertilisers is not more than >20%, while the rest is leached out and contaminating the subsurface water and fix bonded to the calcium content of the soil, that is not available for plants for long term and have no fertilisation effect at all.
  - b. **The soft rock phosphate** with sedimentary origin is the un-processed version of the chemically processed phosphate rock, but that containing even higher levels of toxic cadmium and uranium (30 mg/kg to 210 mg/kg) than the processed versions while the nutrient release capacity is rather low. Traditionally it has been used in organic farming in unprocessed form as soft rock phosphate, but with no any consideration for Cd/U at all. The new EU regulations from July 16, 2022 defining 1.5 mg/kg maximum allowable Cadmium limits for all the bio cases.
  - c. **The mineral phosphate fertilisers produced from phosphate rock poses significant risk to human health and the environment**, therefore the EU maximized the cadmium content of the fertilisers from July 16, 2022 and targeting the replacement of mineral phosphate fertilisers in the agriculture already in short-medium term. The Cd and U is toxic, and once entering the food chain through phosphate fertilisation of food crops, having wide range of human health risks, including the immune-modulator effect, that come up at COVID19 pandemic cases.
- 2) **BONE BASED-APATITE** or ABC Animal Bone Char – **BioPhosphate** which is an unexploited and renewable biomass raw material with high tricalcium phosphate (hydroxyapatite) / calcium phosphate content.



- a) The food grade cattle bones are pure and free from organic and inorganic contaminations and available in economically interesting industrial scale.
- b) The IP protected and proprietary **3R energy independent and zero emission pyrolysis** technology treats the food grade cattle bone grist at as high as **850°C material core temperatures** in absence of oxygen. The end-product is the BioPhosphate which is pure and environmental safe recovered and upcycled product.
- c) In general, bio-fertiliser products, incl. biochar soil improvers and BioPhosphate products, need to be formulated in one or other way. Efficient BioPhosphate applications require specific BIO-NPK-C product formulations as well, which is also part of the 3R technology.
- d) The BioPhosphate industrial production in economical scale is a complex high tech industrial installation/operation, requiring specific engineering knowledge.

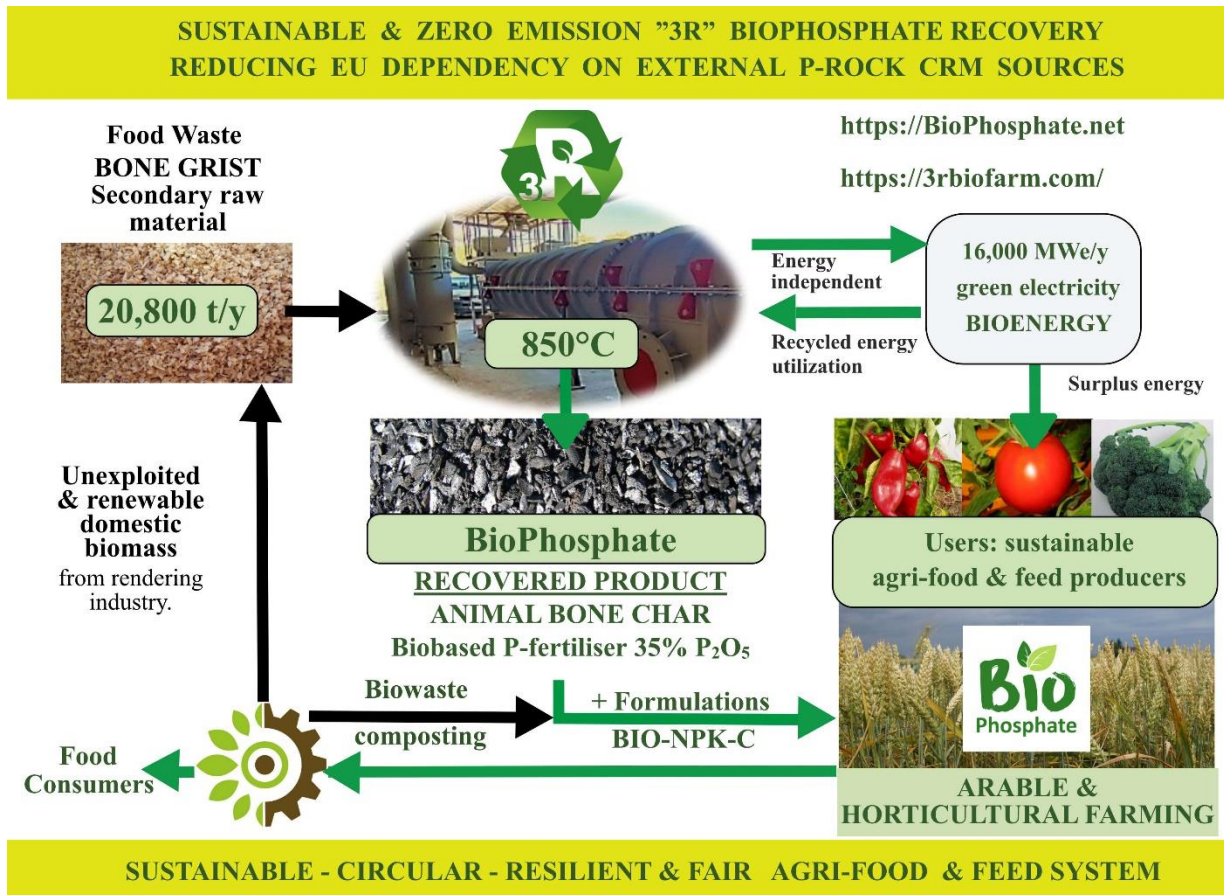
As both materials are same apatite group substances the standard high P concentration is approx. 35% P<sub>2</sub>O<sub>5</sub> in both cases.

**On this Planet Earth, there are no any other natural materials having that economically high P concentration than the apatite based (1) mined mineral phosphate and the (2) animal bone char.**

- ✓ While traditional bone char products have been known since 1820 in the UK, and since 1870 in large industrial scale produced in the UK, the operations stopped in 2001 as the outdated technology and underqualified bone char products did not meet the new EU industrial/environmental regulations and quality requirements anymore and the old system could not be further developed either.
- ✓ In 2002 Edward Someus (3R-BioPhosphate Ltd. ) has been taking over the case and selected by the EC Commission to develop a new generation and modern bone char specific processing technology and safe ABC Animal Bone Char – BioPhosphate products according to the 21<sup>st</sup> century requirements, that successfully implemented over the past 20 years.
- ✓ Edward Someus is the original source for the 3R Zero Emission pyrolysis processing and active formulated BioPhosphate product solution with carbon negative applications. Edward Someus is the sole owner of the IP and industrial design, furthermore the only knowledge center organisation in the EU, which is specialized on all the comprehensive elements (from S&T RTD into full industrialisation) of the phosphorus recovery - bone char case and BioPhosphate system. This 20 years RTD program has gone through several progressive evolutionary steps and by 2022 end reached ready for full industrialization and international commercialization.
- ✓ All phosphate products are classified as Critical Raw Materials as of the approved new EU strategy (COM 2020/474) and the phosphorus recovery is core element of the mega scale Fertilising Products Regulation (EU 2019/1009, which will be implemented from July 16, 2022, The Green Deal and Circular Economy incentives as well.
- ✓ The 3R system has been developed for targeted markets and different climatic/soil conditions, incl. the developed and the developing countries as well.
- ✓ Based on the previous low TRL experiences and results TRL6 prototype developed, designed, implemented and operated under the European Commission FP7 (REFERTIL: Reducing mineral fertilisers and chemicals use in agriculture by recycling treated organic waste as compost and bio-char products, EU contract 289785).

### 3R (Recycle-Recover-Reuse) technology

The specific objective of 3R Recycle-Reuse-Reduce zero emission pyrolysis and phosphorus recovery key enabling technology is the added value upcycling and valorisation of food grade cattle animal by-products into safe and high value recovered organic Phosphorous fertilizer by integrated thermal and active biotechnological formulation processing means.



The 3R proprietary zero emission pyrolysis technology treats the cattle bone grist at as high as **850°C material core temperature** (that is a unique special technical solution) in total absence of oxygen, that unique processing condition requirement is absolute necessary for the bone processing case. Due to the animal bone natural characteristics, there is no any other technical opportunity to produce high grade ABC Animal Bone Char other than 850°C material core temperature, that is required to meet the new regulations beyond 2022 (at least in the high end markets, such as the EU, USA, Australia and Japan). Achieving 850°C high material core pyrolysis temperature require specific innovative design and high tech engineering as well.

The 3R technology zero emission solution is designed **for cases** where all and any material streams are upcycled and reused (converted into safe and valuable products). **The result is** that the process does not produce any emissions (including greenhouse gases) and the product is safe to use **in carbon negative application way**.

The 3R zero emission concept is not only an environmental concept but an economical concept as well, aiming upcycling and reuse all input material streams and converting into added value, safe and market demanded product streams.



The process is energy self-sufficient, auto-thermal and producing large amounts of surplus bioenergy. Pyrolysis bio-oil (a by-product of the treatment process) will be used to provide heat and power to the plant, with any surplus sold to create an additional revenue stream for the plant owner.

- ✓ **The invention:** the original inventor and the sole IP owner of the innovative 3R technology and novel BioPhosphate products is the Swedish upcycling engineer Edward Someus.
- ✓ **RTD:** The 3R technology and BioPhosphate product developments has been executed under the umbrella of the European Commission since 2002, incl. EC co-finance.
- ✓ **Proven demonstrated:** After years of complex development works, the 3R technology has been already fully and long term tested, **TRL6 prototype demonstrated with 2,000 t/y regional capacity**. At the same time full industrial design concept developed for implementation of 20,800 t/y economical scale international capacity operations and its transcontinental replications.
- ✓ **BioPhosphate product tests:** executed under European science and technology cooperation in different climatic and soil conditions and Israel.

#### **Output product = BioPhosphate product family and other added value products**

- 1) **Bio fertiliser** ( <https://biofertilisers.3rbiofarm.com/> ): Economically high concentrated (~35% P<sub>2</sub>O<sub>5</sub> content) phosphorus bio-fertiliser with advantageous high calcium lime content. Soil and soilless media applications developed, incl. microbiological active formulations (PROTECTOR products). MS Authority permit number: 6300/2407-2/2020. EU FPR 20191009 and REACH certifications under progress in 2022. The NUTRIMAN (2018-2031 [www.nutriman.net](http://www.nutriman.net) ) is an important market promotional network in 8 languages and direct contact point for the BioPhosphate products, reaching >1.5 million farmers.
  - a) **The BioPhosphate basic products for controlled release bio-fertiliser applications are always active formulated into BIO-NPK-C compound products as of market demanded content, concentration and performance requirements**, whereas significant value and benefits created for the user.
- 2) **Adsorbent** ( <https://adsorbents.3rbiofarm.com/> ) – **virgin production and regeneration**: unique characteristic adsorbent for water treatment industrial applications for removal of the following contaminants:
  - a) Macromolecular organics.
  - b) Metal and metalloids, such as Cd, Zn, Cu, Cr, As, Pb, aso.
  - c) Removal of fluoride, sulphur and phosphorus content.
  - d) Processing of radionuclide contaminated water at nuclear power plants.
- 3) **Animal feed supplementary**: specific grade animal bone char (*carbo animalis purificatus*) and biochar applications for animal feed supplementary is under development.
- 4) **Other applications**: sugar refinery decolorizing filter, refine crude oil in the production of petroleum jelly, impregnations and coatings, preservative, black pigment for artist's paints, aso.
  - a) The bone char production also providing bone oil (**oleum animale**) by-products, also called Dippel's oil, a nitrogenous by-product of the dry distillation manufacture of bone char. The 3R



technology uses bone oil for bio-energy production with innovative opportunity to extract ammonium nitrate bio-fertiliser.

- a) **Green energy:** The 3R process is auto-thermal and energy positive, e.g. onsite producing more energy than use and providing several added value positive effects. **Unit 20k** with 20,800 t/y throughput capacity: green electricity energy production ~ 2MWe/h from which the surplus uploaded to the grid. All thermal energy is recovered and reused onsite.
- 5) **Biochar:** the 3R technology is optimal for high end manufacturing of wide range of products from wide range of organic inputs as well, incl. plant based Terra Preta biochar for soil improver and metallurgical applications.

The European Commission is amending FPR Fertilising Products Regulation (EU) 2019/1009 of the European Parliament and of the Council for the purpose of adding pyrolysis/gasification materials as a component material category CMC 14. In the case of BioPhosphate (CAS 8021-99-6 Bone Charcoal, EC 232-421-2) the input bone meal material fully meet the new FPR conditions where category 2-3 bone grist used, 133°C <sup>20 min</sup> 3 bar pressure sterilized and delivered from EU/MS approved/registered rendering industrial plant. Few key treatment conditions compared 3R BioPhosphate/3R Terra Preta Biochar versus FPR products such as:

Treatment conditions, criteria and maximum allowable limits	EU FPR general (all) products	3R BioPhosphate specific products	3R Terra Preta Biochar specific products
Processing temperature minimum °C	above 180	850	450
Processing residence time minimum	2 sec	20 min	20 min
*PAH <sub>16</sub> (dry matter) mg/kg	6	**PAH <sub>19</sub>	**PAH <sub>19</sub>
**PAH <sub>19</sub> (dry matter) incl. PAH <sub>16</sub>	n/a	1	1
***Cadmium (dry matter) mg/kg (bio cases)	1.5	1.5	1.5

\* The high toxic 16 EPA PAHs Polycyclic Aromatic Hydrocarbon are the outdated US standards applied since 1976.

\*\* The 19 EPA PAHs update is used at some Member State permit regulations that is applied since 2005 after modernization of the 30 years old 16 EPA PAH standard.

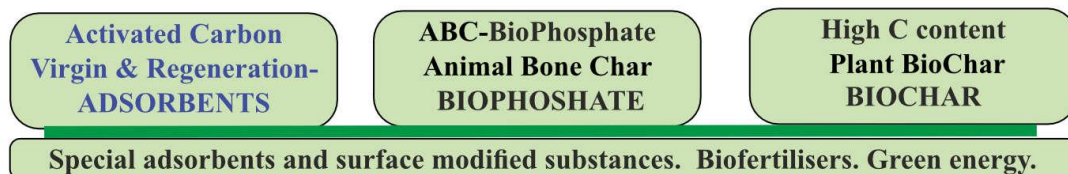
\*\*\* By July 16, 2022 the EU FPR Fertilising Products Regulation is decreasing the so far applied from <90 mg/kg toxic cadmium content in fertilisers down into 1.5 mg/kg maximum allowable limit for the bio-cases.

BioPhosphate is apatite based calcium-phosphate with ~35% P<sub>2</sub>O<sub>5</sub> content to replace the toxic Cadmium/Uranium content natural soft rock phosphate in the organic farming sector and the chemically processed mineral phosphates in the intensive farming sector. Plant based biochar is soil improver.

## ”3R” zero emission and energy independent carbon refinery technology Application map 2023

3R reductive thermal processing in any range up to <850°C material core temperature.

**High temperature reductive thermal processing <850°Celsius material core temperature processed**



... and many other application areas, incl. petroleum jelly, coatings, preservative...



**Low temperature reductive thermal processing <450°Celsius material core temperature processed**

<https://BioPhosphate.net>    <https://3rbiofarm.com/>

### Company history:

The 3R-BioPhosphate Ltd. „3R” is an thermal processing heavy industrial engineering and manufacturing organization since 1989 that is originally established as joint venture (Lang Carbon Ltd.) with the subsidy of the French multinational ALSTOM Power (since 1928) that is Lang Machine Works (since 1868). Edward Someus has been one of the original joint venture partner founder, managing director and chief engineer of the 3R since 1989. This professional company is specialized for added-value industrial recycling and upcycling of biomass by reductive thermal processing, carbon refinery, pyrolysis and objective driven towards low carbon future defined by the ALSTOM Power.

The 3R is an independent industrial engineering and manufacturing organization since 2001 and today is the international leading specialist and knowledge centre for industrial engineering and manufacturing of the carbon refinery/pyrolysis solutions and sustainable reuse of refined carbons. The core corporate value is the economical scale industrialization of innovative environmental and sustainable climate solutions through the full value chain, most importantly the 3R specific and unique innovative design for energy self-sustaining and zero emission upcycling of biomass. The output products are the market demanded recovered biophosphate fertilizers, biochar, adsorbents and carbon sequestrations.

- Since 2011 the 3R is EU policy development consultant organization for the European Commission DG Grow and had active contribution for the development of the Fertilizing Products Regulation (EU) 2019/1009 and related legal content, especially for the biochar and phosphorus recovered products. In this context the company have deep understanding and knowledge about all relevant regulations, such as



The European Green Deal, Circular Economy Action Plan, Farm-to-Fork, REACH, Industrial Emission Directive, Paris Climate Agreement, Waste Framework Directive and all other related EU and MS industrial, environmental and climate regulations.

- The 3R is also specialized on to compile full dossier for EU and MS Authority permitting to set up first-of-a-kind full industrial operational technology installation and commercial production operations. The Authority permitting set up operations also related for innovative products commercial permitting as well, such as EU REACH (EC 1907/2006, EU FPR 2019/1009 Nominated Body certifications and Authority permits.
- Since 2002 the European Commission significantly co-financed the 3R innovation, technology and product developments, for biomass recycling and upcycling under large scale EU Framework programmes for FP5, FP6, FP7, H2020 and Horizon Europe for which successful actions the company has been the full coordinator and key technology designer.
- The main aim of these EU collaborative actions has been to convert application driven scientific knowledge/results into economy driven market competitive industrial practice, while preserving the advanced environmental/climate goals particularly the zero emission processing one. With solid and excellent industrial background, the 3R company have all the needed and specialized industrial engineering, manufacturing & operational experiences; knowledge; competence and management team resources for industrial and business realization of next higher TRL steps.

#### **More information:**

<https://www.biophosphate.net>   <https://www.3rbiofarm.com>  
<https://biophosphate.net/video>  
<https://youtu.be/ECfxpO3TI3w>   <https://youtu.be/02tikiRUxs0>  
<https://youtu.be/QjUpDIEGBBw>

- 1) 3R (Recycle-Recover-Reuse) zero emission pyrolysis innovative processing and upcycling technology: [https://nutriman.net/farmer-platform/technology/id\\_193](https://nutriman.net/farmer-platform/technology/id_193)
- 2) 3R BioPhosphate products active formulated for carbon negative agricultural or adsorbent applications: [https://nutriman.net/farmer-platform/product/id\\_192](https://nutriman.net/farmer-platform/product/id_192)
- 3) 3R Terra Preta Biochar products active formulated for carbon negative agricultural or adsorbent applications: [https://nutriman.net/farmer-platform/product/id\\_1571](https://nutriman.net/farmer-platform/product/id_1571)

#### **Contact:**

Edward Someus (upcycling engineer, Sweden)   [biochar@3Ragrocarbon.com](mailto:biochar@3Ragrocarbon.com)  
Skype: edwardsomeus TEAMS connected Tel: +3620 2017557 +3620 8054727  
Address: 2472 Kajaszó, Biofarm Road 58/3, 3R-Biofarm Upcycling Centre, Hungary