>> ELECTRON TREATMENT OF SEED <<

- an environmental friendly treatment method with future potential -

Post-Neonikotinoid-Symposium
01. Dezember 15, Berlin, Germany

Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP
Dresden, Germany

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Content

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How does it work

History – 25 years of electron treatment

Fraunhofer FEP

Fraunhofer FEP
Fraunhofer-Gesellschaft

- is Europe's largest application-oriented research organization
- was set up in 1949
- 66 institutes and independent research units with 22,000 employees all over Germany
- the headquarters is located in Munich
- each institute has its own core competences
- the individual institutes act as profit centers on the market


Headquarters in Munich

Fraunhofer FEP

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Facts and Figures

- Employees: 193
- Total budget: 25.8 M€
- Industry returns: 8.3 M€
- Public funding: 9.0 M€
- Investments: 2.3 M€

(March 2015)

Director

Prof. Dr. Volker Kirchhoff



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How does it work

History – 25 years of electron treatment

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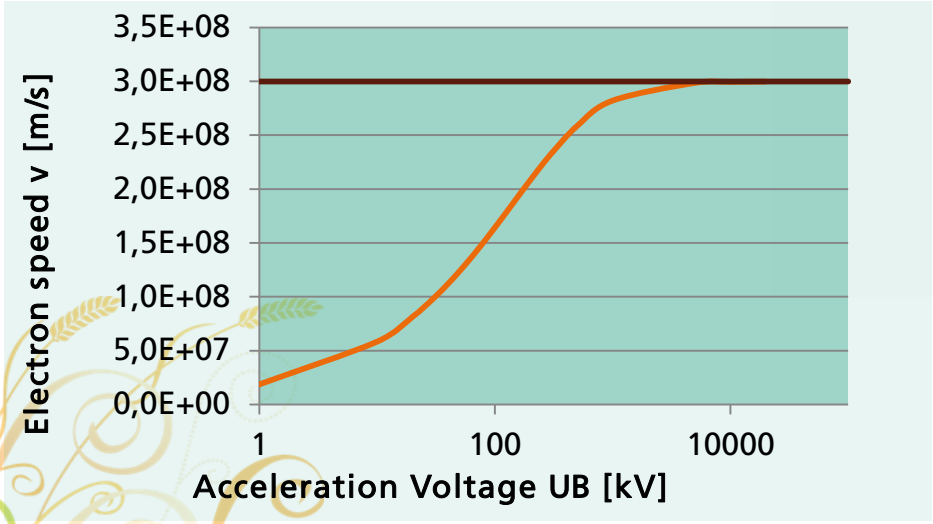
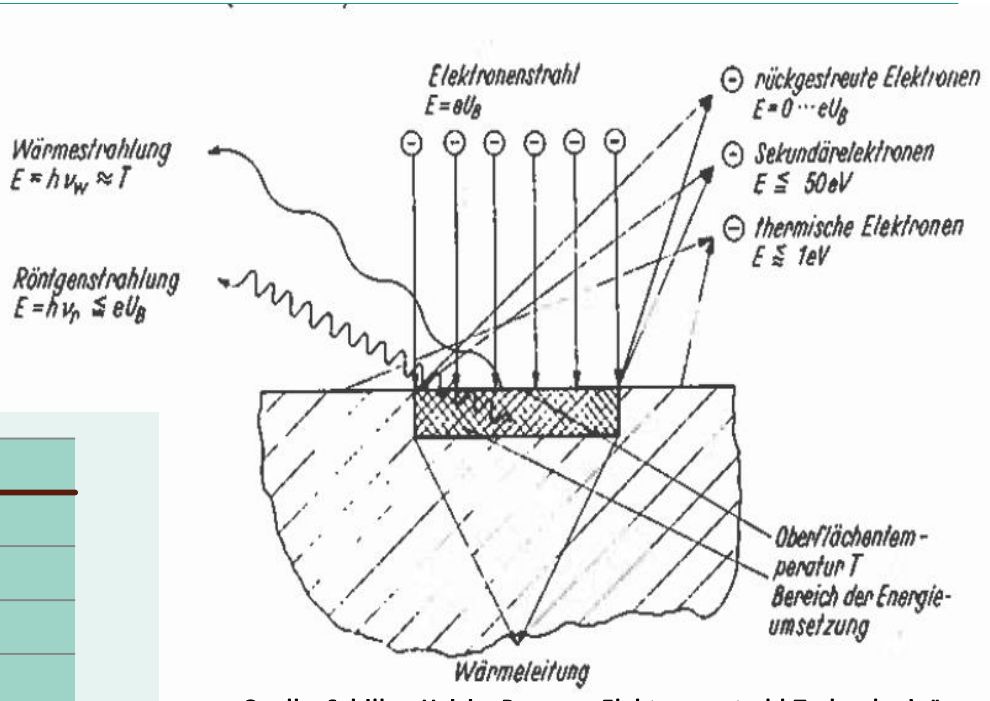
How does it works

Basics: Electron speed and interactions

- Acceleration of electrons up to a speed of10^8 m/s
- The kinetic energy of the electrons is converted in the substrate





Quelle: Schiller, Heisig, Panzer: „Elektronenstrahl-Technologie“, FEP, 1995

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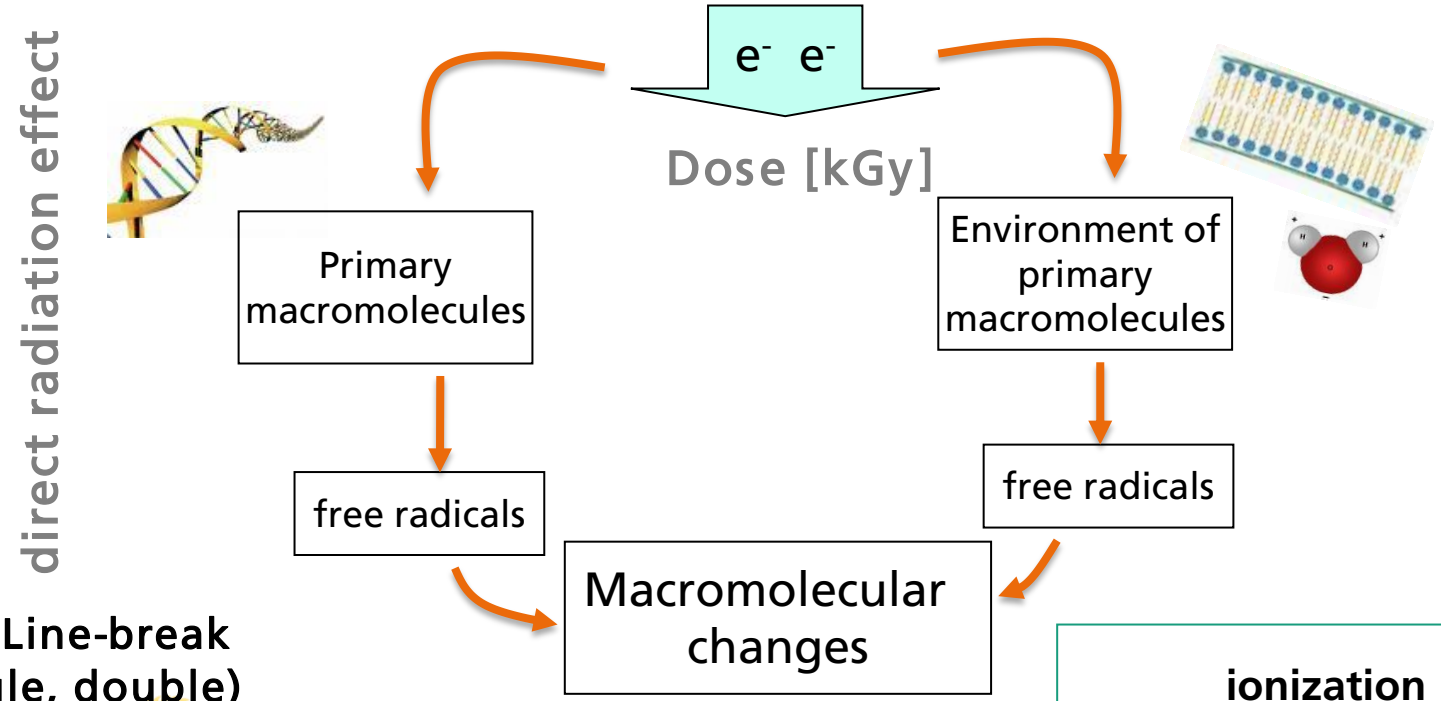
How does it work

Biocidal effect



- DNS Line-break (single, double)
- Change or damage of bases
- Denaturation
- Cross linking
- Adsorption of proteins

ionization

$H_2O \rightarrow H_2O^+ + e_{aq}$

decomposition

$H_2O \rightarrow H^+ + OH^-$

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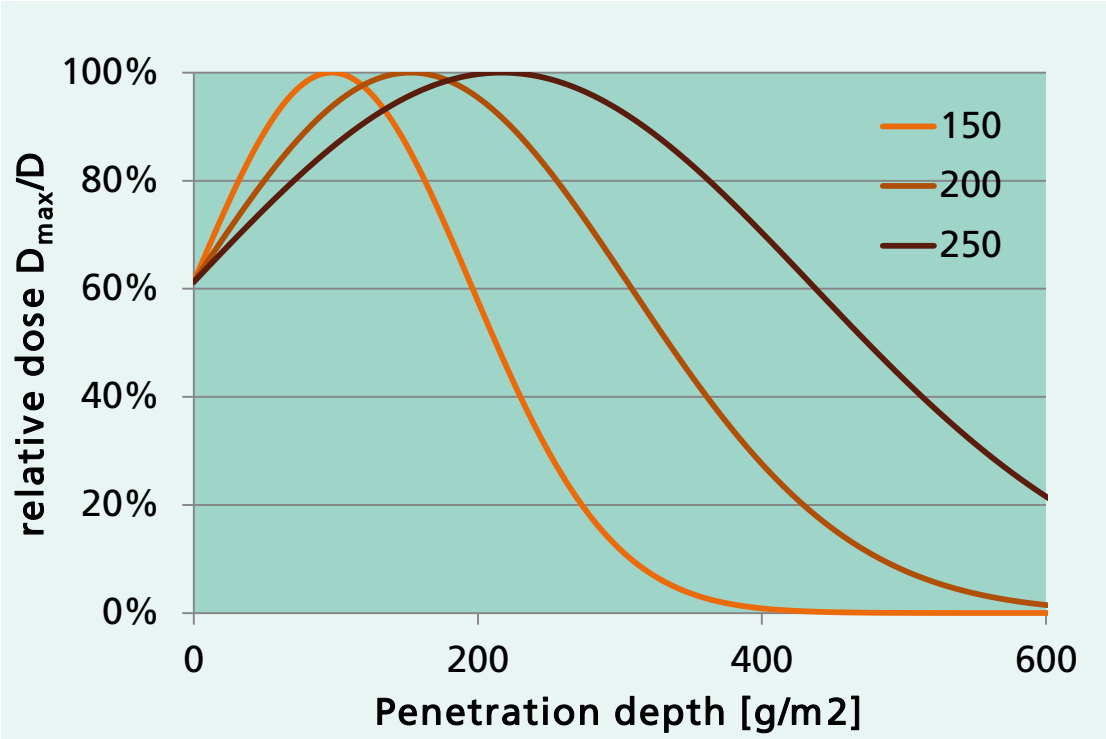
How does it works

Basics: Penetration depth

$$-\left(\frac{dE}{dx}\right)_{ges} = -\left(\frac{dE}{dx}\right)_{Koll.} - \left(\frac{dE}{dx}\right)_{Str.} - \left(\frac{dE}{dx}\right)_{Paar} - \left(\frac{dE}{dx}\right)_{Photo} - \left(\frac{dE}{dx}\right)_{Comp.} - \left(\frac{dE}{dx}\right)_{Hadr.}$$

- Electrons interacts with the material
  - Ionization of atoms
  - Excitation of electrons
  - Bremsstrahlung
- Limited penetration depth
  - Acceleration voltage
  - Density and thickness



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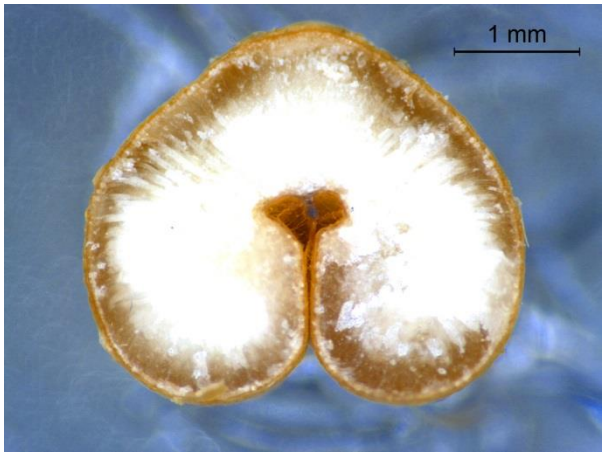
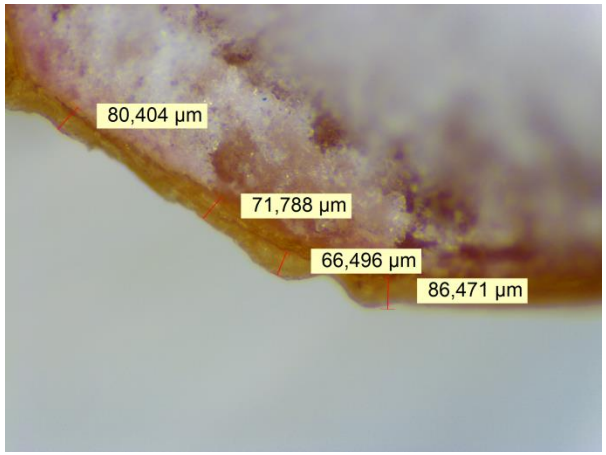
How does it works
Adjustment of machine





$$S \approx 6{,}67 * 10^{-11} * \frac{(U_B * k_1)^{\frac{5}{3}}}{\rho} * k_2$$

Quelle: Schiller, Heisig, Panzer: „Elektronenstrahl-Technologie"; FEP, 1995

- Calculation of acceleration voltage, depending on
  - Seed shell thickness and density
  - Distance to emitter
- Calculation of current, depending on
  - Aimed dose

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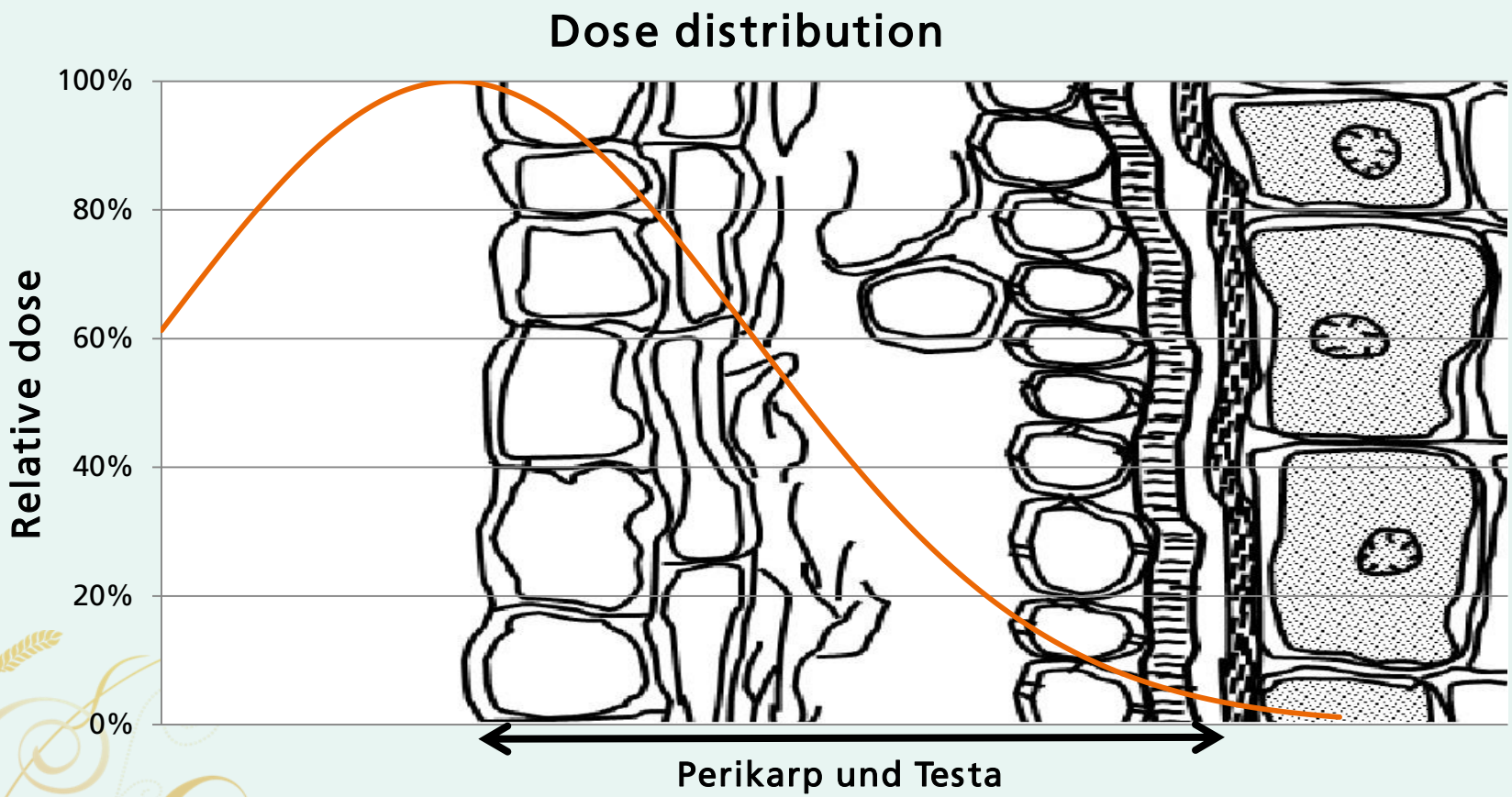
How does it work

Basic principle



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How does it work

History – 25 years of electron treatment

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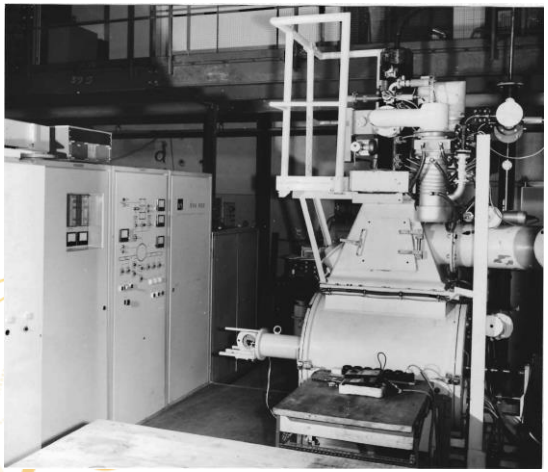
History – 25 years of electron treatment
Motivation

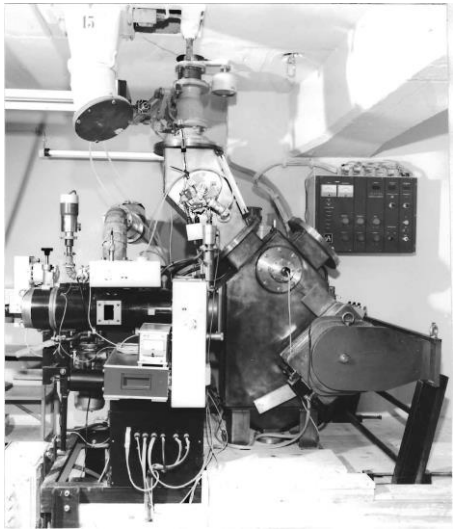
- Using of mercury based seed treatment agents was the common practice until the 80th
- Increasing problems with mercury residues in food caused by heavy metal accumulation in soil
- Special economical situation in the former East Germany
- Development of new chemical agents was very expensive
- Searching to new alternative technologies
- Biocidal effect of ionized radiation is well known since 1905
- But penetration sensitive method is necessary, because the embryo has to be untouched
- X-ray and gamma radiation are unfeasible therefore
- First idea of using accelerated electrons was tried 1980 at the private Research institute Manfred von Ardenne

History – 25 years of electron treatment
First testing equipment

- Electron treatment system ELBA 50
  - 1 Scanned electron beam 50 kV
  - 1983
  - 5 kg batch treatment in rotary screen
  - Wheat treatment under vacuum

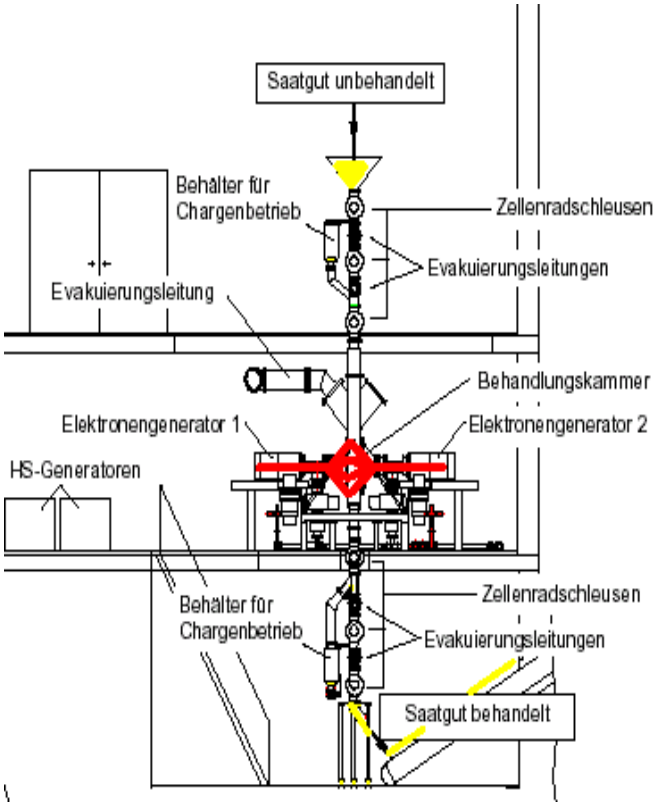


- ELBA 60-1
  - 1 Scanned EB 60 kV
  - 1987 Weinböhla
  - Semi-Batch treatment in vacuum in rotary screen



History – 25 years of electron treatment
Testing equipment for continuous treatment

- Pilot plant WESENITZ 1
  - 2 Scanned EB, 60 kV
  - 1995
  - **Continuous treatment** in vacuum
  - Throughput: 10 t/h



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History – 25 years of electron treatment
Pilot plant

- 1997: Electron treatment with industrial-like throughput

- Mobile treatment plant WESENITZ 2 (FEP)
  - 2 line emitting sources, 145 kV
  - Continuous treatment on air
  - Throughput: 30 t/h

History – 25 years of electron treatment
Technology today

More than 10 years successful industrial pilot operation.
June 2011 selling the pilot plant to BayWa and Nordkorn for real farming use.

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