ELECTRON TREATMENT OF SEED

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Department E-Processing
André Weidauer
Andre.Weidauer@fep.fraunhofer.de
Content

Fraunhofer FEP

State of the art - Seed production

How does it work

Technology and machine concepts
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
Fraunhofer FEP
Non-thermal electron beam processes

- Application examples

**Polymers**
Crosslinking
Hardening
Grafting
Functionalization

**Lacquer hardening**
Bulk good
Plates, papers
3D substrates

Quelle: ROBERT BOSCH AG

Waste water
Waste gas

New machines

Medical devices

(*) Reference: iStockphoto.com/fhgfep
State of the art - Seed production

How does it work

Technology and machine concepts
Seed production
State of the art

- Breeding
  - Cultivation and breeding
    - Basic seed

- Propagation
  - Seed propagation/multiplication
    - Certification of seed

- Seed Treatment
  - Seed producers:
    - Chemical seed dressing
      - adapted to kind of seed and pathogens

- Farming
  - Farmers:
    - Breeding/Production of cereals, corn, ... for feed, food and further production

Reference: iStockphoto.com/fhgfep
Seed production
State of the art

Negatives of chemical seed dressing

- Waste products in water and soil
- Very expensive registration and permission procedure for new products
- Year by year less chemicals are allowed to use
- Drifting of dressing agents
- Development of resistant pathogens

DEMAND FOR ALTERNATIVES!!!

- Biologicals (Fungus, Bacteria, biological fertilizers)
- Physical Treatments (Hot Steam, Hot Water, Microwaves, UV, Plasma, Electrons)
How does it work
Technology and machine concepts
How does it work
Basics: Penetration depth

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

\[ S \approx 6.67 \times 10^{-11} \times \frac{(U_B \times k_1)^5}{\rho} \times k_2 \]

Ref.: Schiller, Heisig, Panzer: „Elektronenstrahl-Technologie“; FEP, 1995
How does it work

Basic principle

Dose distribution

Relative dose

Perikarp und Testa
How does it work

Basic principle

TREATED SEED  HEALTHY GROWING  HEALTHY CEREALS

No impact on soil, ground water or farmer

Reference: iStockphoto.com/fhgfep
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Fraunhofer FEP

State of the art - Seed production

How does it work

Technology and machine concepts
## Technology and machine concepts

### Technical Requirements

- **Electron energy**: 90 – 150 keV
- **Dose rate**: >> 3000 kGy m/min
- **Homogeneity**: Dose on every surface point of every seed grain
- **Maintenance**: On-site maintenance and replacement of selected parts with more frequent service requirements
- **Seed handling**: Buffering of seed conveyers from the producer. Singled, rotating grains
Technology and machine concepts
High Throughput

- Throughput (continuous process)
  - Cereals: max. 30,000 kg/h
  - Vegetables: max. 12,500 kg/h
Technology and machine concepts
High Throughput

- Highest cost efficiency (cost of machine per throughput per hour)
- 2 line emitters (30 kW, 150 keV)
- Fully automated process and documentation
- Interfaces to production facility (product transportation, packaging)
- Online control unit for process monitoring
- Changeable electron exit windows, on-site maintenance, no service-requirements by developer or manufacturer
Technology and machine concepts
High Throughput

- Since 1999: Mobile pilot plant (first equipment)
- Since 2015: Stationary equipment (automatized concept)
- From 2018: Container-mounted system (standardized interfaces)
Technology and machine concepts
High Throughput

Selled as: E-PURA®, E-VITA®

annual amount [t]

0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000


BayWa Nordkorn Saaten Drittanwender
Technology and machine concepts
Low and medium throughput

- Throughput - scalable
  - Cereals: 5,000 - 15,000 kg/h
  - Vegetables: 1,000 - 3,000 kg/h
Technology and machine concepts
Low and medium throughput

- High cost efficient for throughputs < 15 tons per hour
  - **New electron emitter concept (1 emitter, 1 set of periphery)**
    - Scalable ring shaped electron source
    - Cold plasma → ions
      ions hit cold cathode → secondary electrons
Technology and machine concepts
Low and medium throughput

- Modularity (Mobil or stationary use)
- Fully automated process and documentation
- Online control unit for process monitoring
- Changeable electron exit windows, on-site maintenance, no service-requirements by developer or manufacturer
Thank you for your attention

Andre Weidauer
Fraunhofer FEP
Winterbergstr. 28
01277 Dresden / Germany

Tel.: +49 (0) 351 2586 – 164
Fax.: +49 (0) 351 258655 – 164
Andre.Weidauer@fep.fraunhofer.de
seed-health@fep.fraunhofer.de

Reference: iStockphoto.com/fngfep