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Experimental plant for the treatment of liquids with low-energy accelerated electrons

ELLI 300

Experimental plant ELLI 300

In the ELLI 300 experimental plant, aqueous solutions are treated with low-energy accelerated electrons (< 300 keV). The ELLI 300 was designed as a research and development platform for low-energy electron beam technology. The system is based on a 300 kV electron beam generator with an irradiation chamber that can be equipped modularly. The system parameters are variable, so that the penetration depth and intensity of the electron beam can be adjusted precisely. While treatment with high-energy electrons allows deep penetration into aqueous solutions, a treatment with low-energy electrons results in a reduced penetration depth in the liquid. The equipment of the system with modules for controlled liquid flow allows low-energy electron beam technology to be used economically for aqueous solutions and enables application-specific treatment of the substrate.

Procedure for fluid control on ELLI 300

In the first process, a roller module is inserted into the system, which is located in a removable cassette (Fig. 1). The module is based on a stainless steel roller for continuous transport of the liquid in a thin film. The rotation of the roller causes the continuous wetting of it and the transportation of liquid under the electron beam source.

After the treatment, the liquid is stripped off and collected in a sterile container. In this continuous process, a throughput > 4 l/h can be achieved.

The second process is carried out with a pouch module (Fig. 2) and is based on the treatment of the liquid in a sealed pouch (20 ml), which is pulled over a drive roller. It is also possible to transport a sequence of pouches containing different liquids.

Several published studies have demonstrated the proof-of-concept for inactivation of pathogens with low-energy electron beam technology [1, 2]. The kinetics of inactivation of various bacteria by low-energy electron beam irradiation has been investigated.

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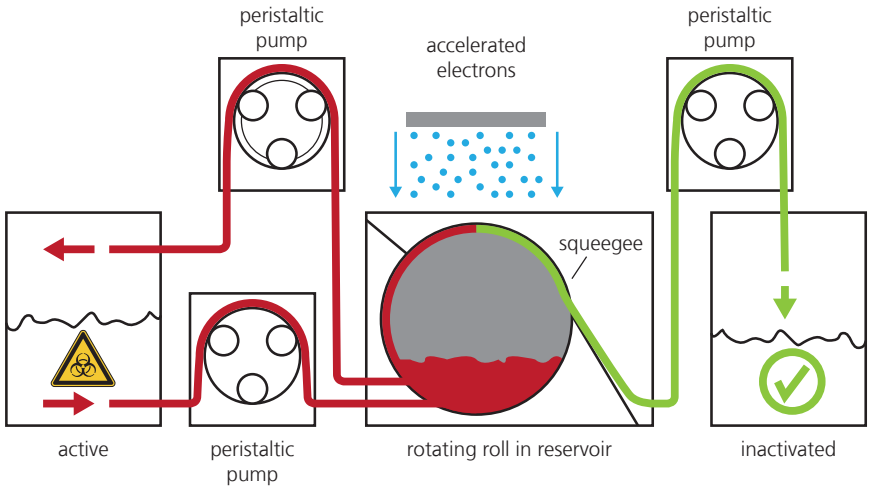

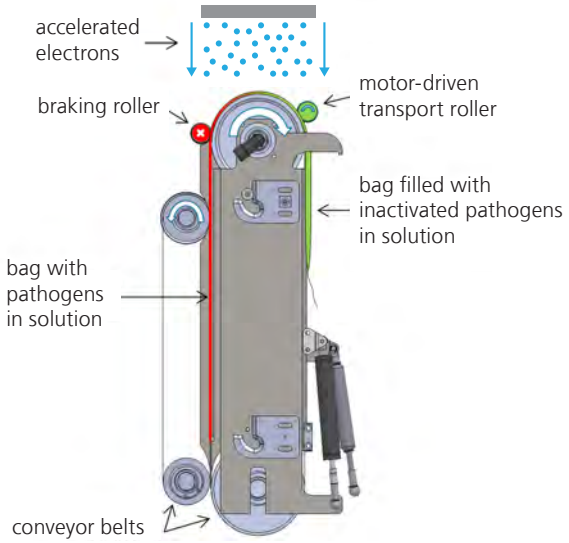

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Applications

- Inactivation of pathogens, such as bacteria, viruses, parasites for vaccine production
- Irradiation of cells for inhibition of proliferation [3]
- Development of novel vaccines, cell and gene therapeutics
- Treatment of blood components
- Germ reduction in or sterilization of liquid biological media
- Investigation of radiation hormesis or stimulation of the activity of bacteria or cells
- Reduction of pollutants in waste water
- Applications in environmental technology based on aqueous systems

Our Offer

- Test facility for low-energy electron beam technology for research and development projects
- Pre- and feasibility studies
- Scaling from laboratory to industrial scale
- Technology development for customer specific application
- Monitoring, control and optimization of process critical parameters for your application

Technical Data

Electron beam	Type EBA 300/270/4 with max. 300 keV
Process conditions	Atmosphere
Process measurement technology	■ Various dosimetry systems ■ Online beam monitoring ■ Cell and microbiological analysis ■ Diagnostic tests
Modular plant concept	Continuous roller module e. g. for inactivation of bacteria and viruses as well as for irradiation ■ Throughput > 4 l/h ■ Coolable ■ Measurement of layer thickness possible Pouch module e. g. for inactivation of bacteria, viruses, parasites and for inhibiting the proliferation of cells ■ 20 ml per run ■ Throughput < 0.5 l/h ■ Coolable ■ Measurement of layer thickness possible

Literature

[1] Fertey J, Thoma M, Beckmann J, Bayer L, Finkensieper J, Reißhauer S, et al. Automated Application of Low Energy Electron Irradiation Enables Inactivation of Pathogen- and Cell-Containing Liquids in Biomedical Research and Production Facilities. Sci Rep (2020) 10:50. doi: 10.1038/s41598-020-69347-7

[2] Fertey J, Bayer L, Grunwald T, Pohl A, Beckmann J, Gotzmann G, et al. Pathogens Inactivated by Low-Energy-Electron Irradiation Maintain Antigenic Properties and Induce Protective Immune Responses. Viruses (2016) 8:319. doi: 10.3390/v8110319

[3] Walcher L, Kistenmacher AK, Sommer C, Böhlen S, Ziemann C, Dehmel S, et al. Low Energy Electron Irradiation Is a Potent Alternative to Gamma Irradiation for the Inactivation of (CAR-)NK-92 Cells in ATMP Manufacturing. Front Immunol (2021) 12:684052. doi: 10.3389/fimmu.2021.684052

1 Modules for liquid transport; left: Roller module; right: pouch module. Illustrations from [1]

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