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Microwave Vacuum & Freeze Drying

Presentation PowTech 13.Oct 2011 Nürnberg

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Content of Presentation

- Motivation
- Application Categories in dielectric heating
- Microwave Vacuum Drying
- Microwave Freeze Drying
- Microwave Design Setup for Freeze Drying
- Configuration Examples for µWaveDryerxx50
- Mw FD Application Examples:
    - Horse Radish / Radish
    - Strawberries / Raspberries
    - Chemical Raw Material
- Summery

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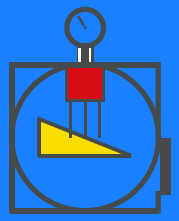
Motivation

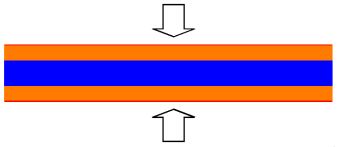
40-70h FD Drying Time based on Shelf Logistic

2-4h FD Drying Time based on Drum Logistic

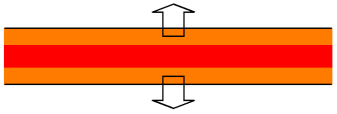
24kW MW FD

- **In the time we developed Microwave Vacuum Driers, conventional freeze drying was always the quality reference for texture, appearance, color etc.**
- Conventional freeze driers were developed in an incremental way, but no real innovation happened in the past decades
- Due to extreme long drying times conventional freeze driers are economical under pressure (especially as steel prices are increasing significantly)
- Due to the long drying time, volatile compounds like aromas, antioxidants etc. get lost
- Shelf based material handling is difficult for full automated processes.





Conventional Heating



Microwave Heating

Application Categories in Mw-Vacuum Drying

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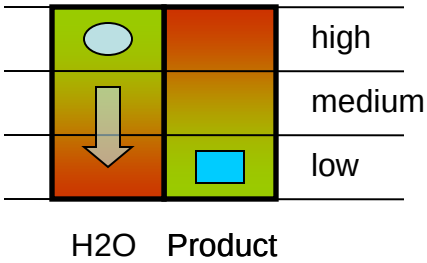
Inorganic Inert Chemicals

like Drying of Si-Powder

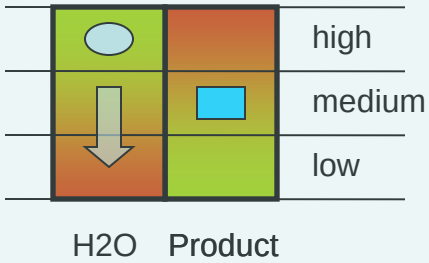
Ability to absorb microwave energy



Not critical

Organic Chemicals Biotec and Food

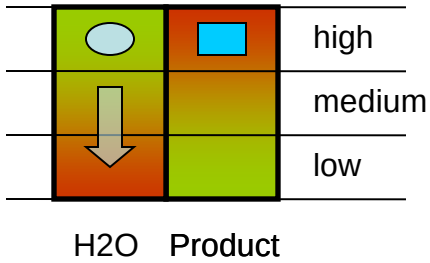
Like Drying pharmaceutical raw materials



becomes critical at MC < 5-10%

Active Chemicals

Like Drying of Graphite and SiC-Powders



Very critical

Application Categories Mw-Vacuum Drying versus Mw-Freeze Drying

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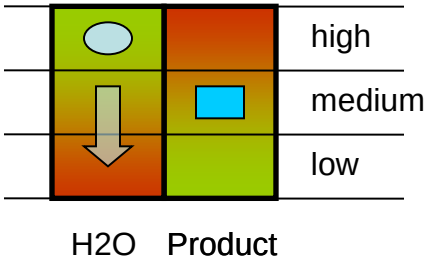
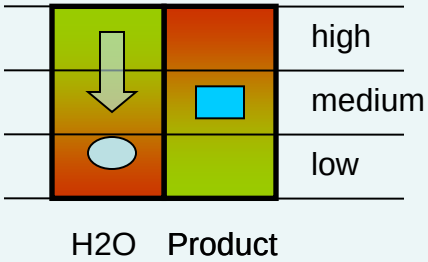
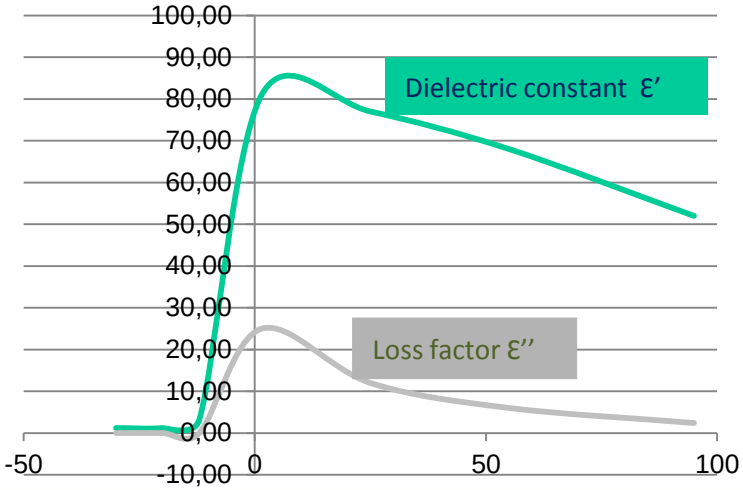
Organic Products under Mw Vacuum Drying Conditions



Organic Products under Mw FD Conditions



- In frozen conditions water molecules cannot move and the dielectric losses are low.
- Dielectric products losses mainly determined by product itself.



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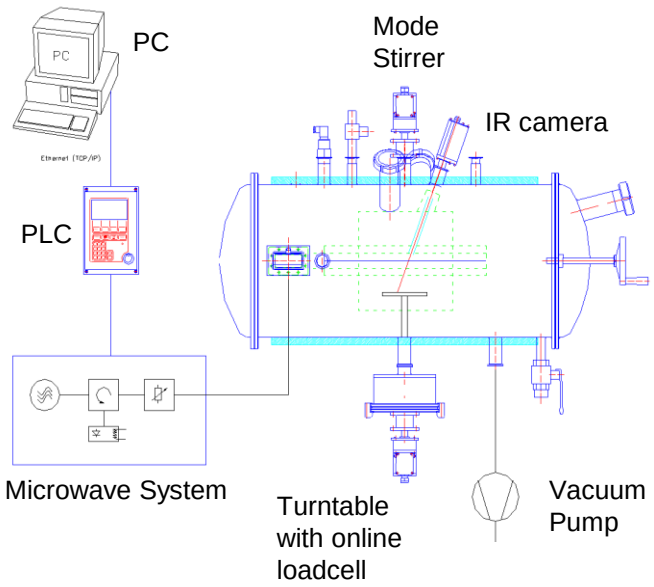
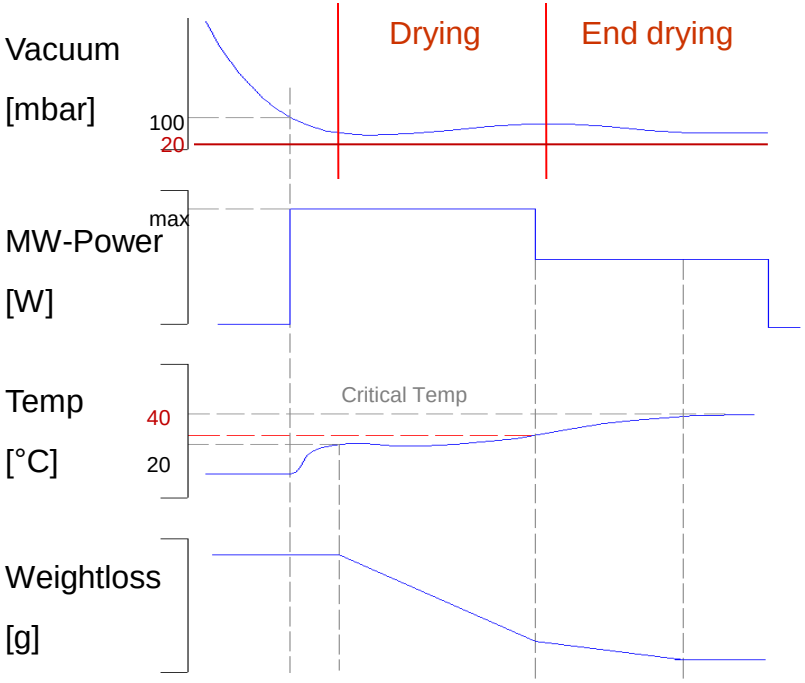
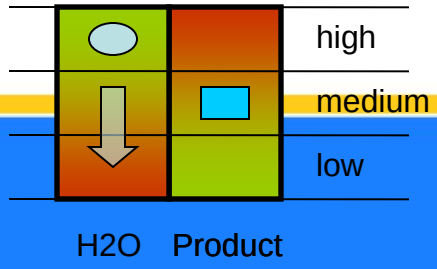
Microwave Vacuum Drying





Biotec and Food



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Microwave Freeze Drying System based on Rotating Drums

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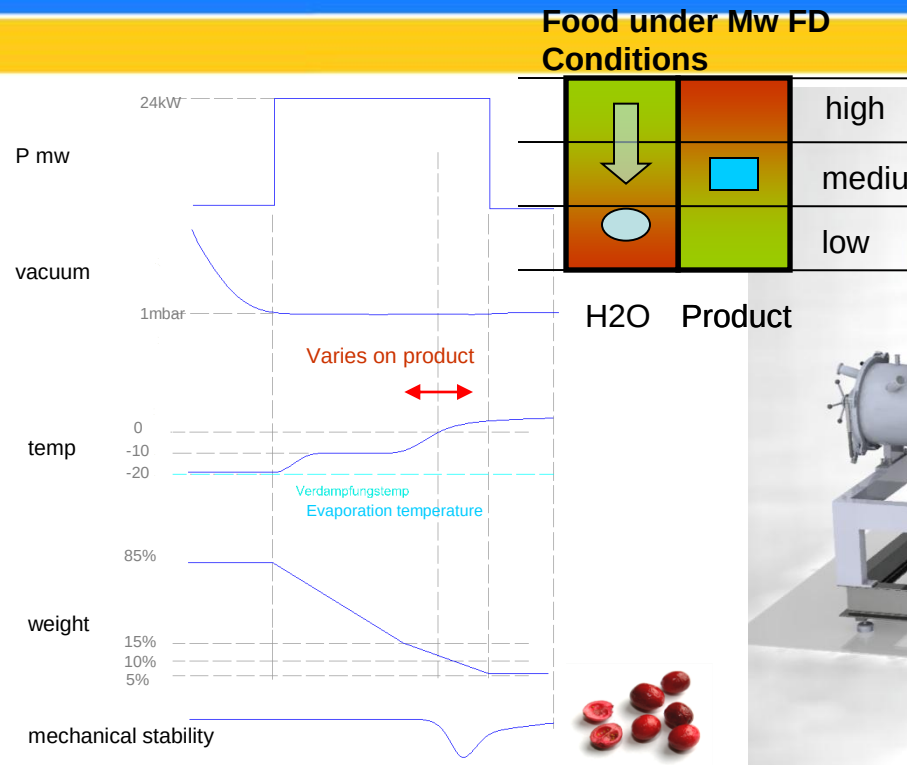

Food under Mw FD Conditions

Design of an Industrial Microwave Vacuum System

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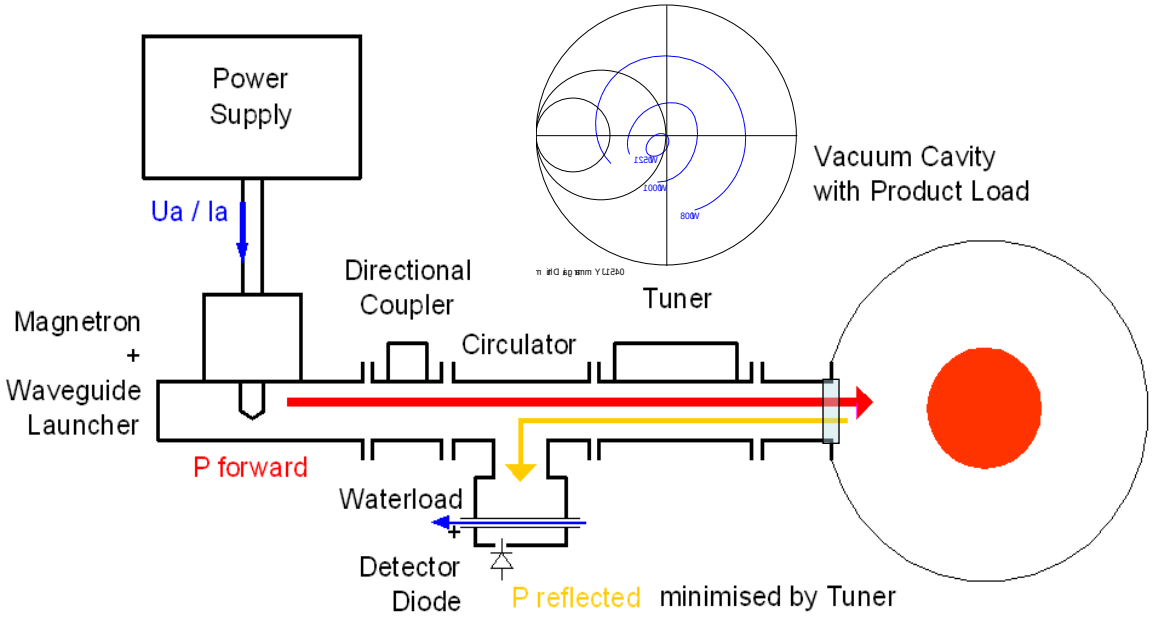

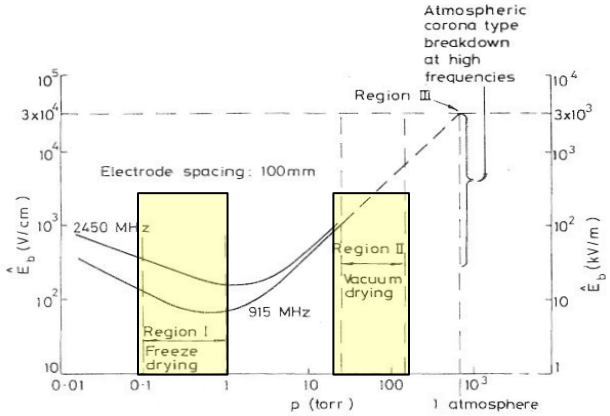

In order to avoid Arcing & Plasma an excellent Microwave Design is required

Different Configurations of the Lab µWaveVacxx50

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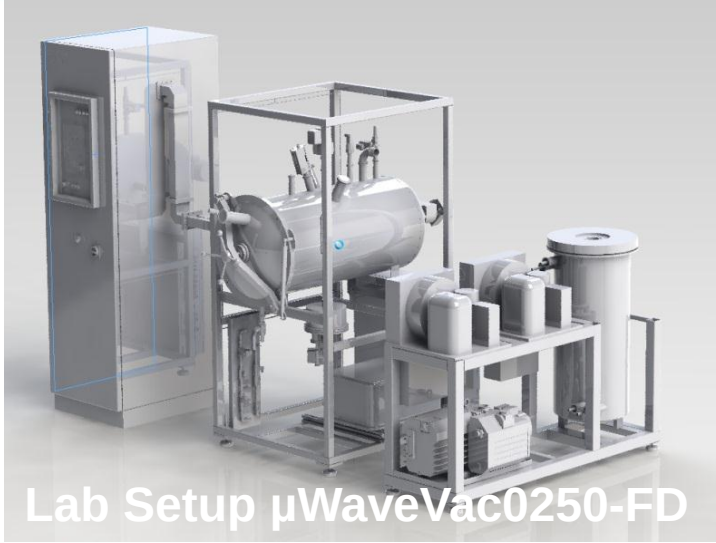
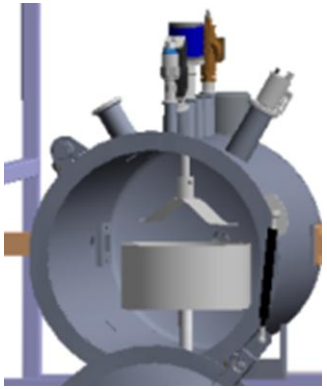
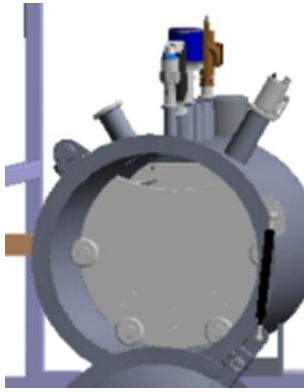
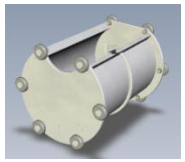


2kW/2450MHz Mw FD with 2kW @ -50°C chiller/condenser for vacuum levels of 1mbar

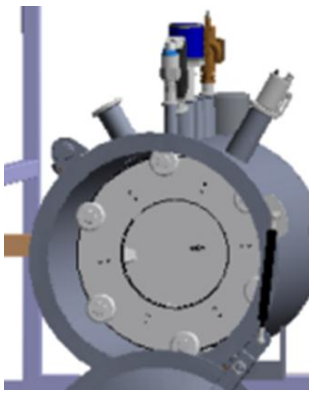


Turntable Operation





50 ltr Open PP Drum



50 ltr Closed PP Drum

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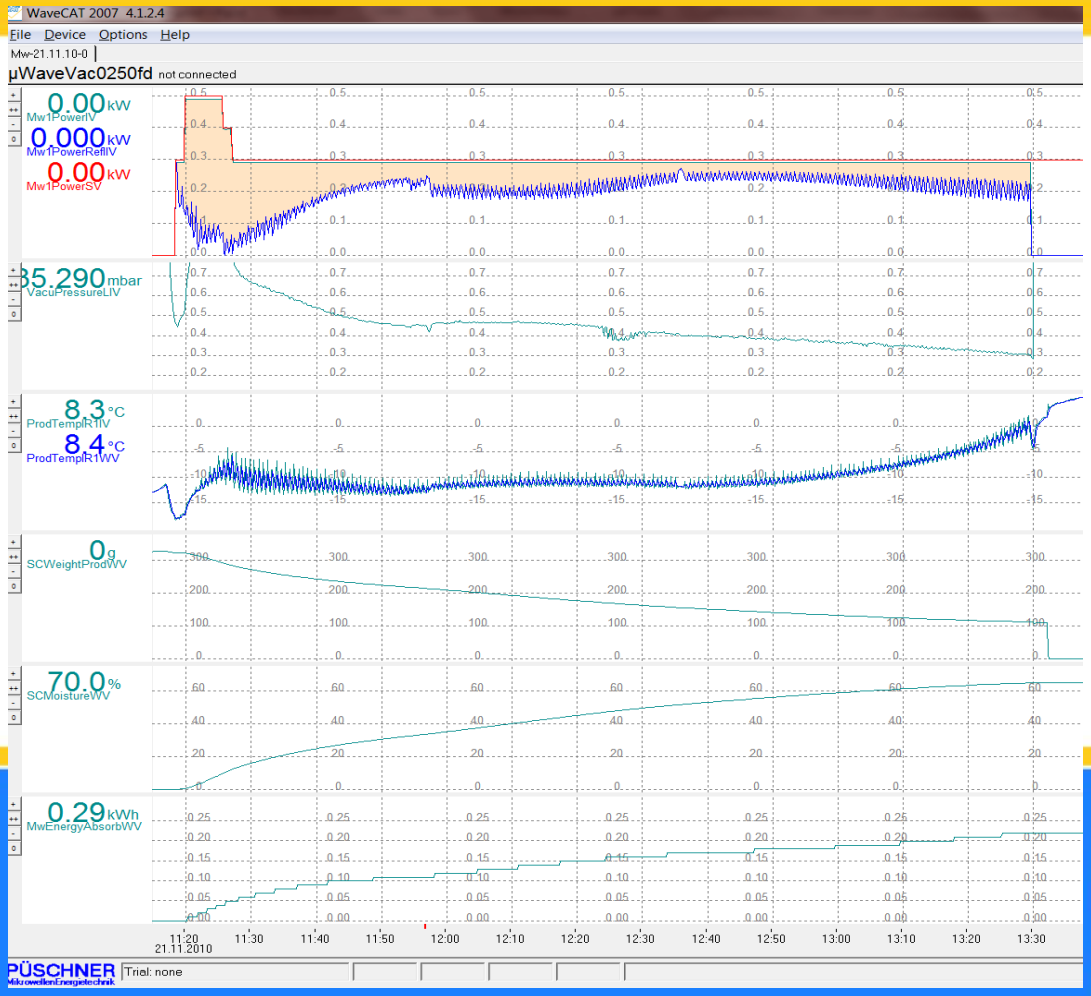
Mw FD of Horse Radish on Turntable



Param	Values
Start weight	346g
Initial MC	68%
End weight	110g
End MC	3-10%
Drying Time	2h
Max Temp	5°C

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Mw FD of Radish on Turntable

	Combi MW FD & VD	MW FD	Conv FD
Dry Time	2h	4h	40h
Max Temp	40°C	10°C	40°C
Weight per piece	0.58g	0.59g	0.52g
Ratio Dehyd	2-3	6-8	10.0-14.0
Aroma	good	Very good	Poor

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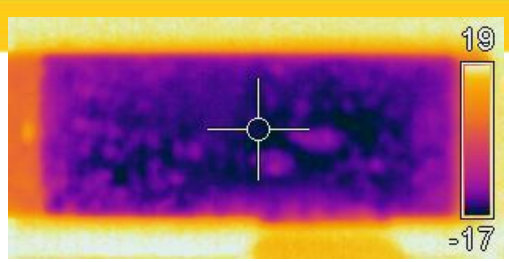
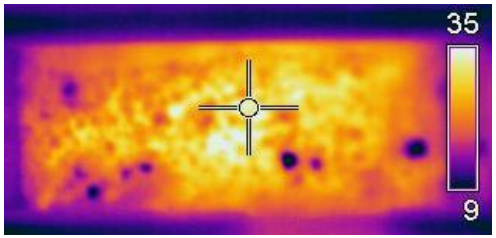
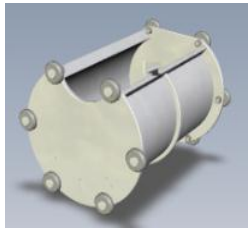
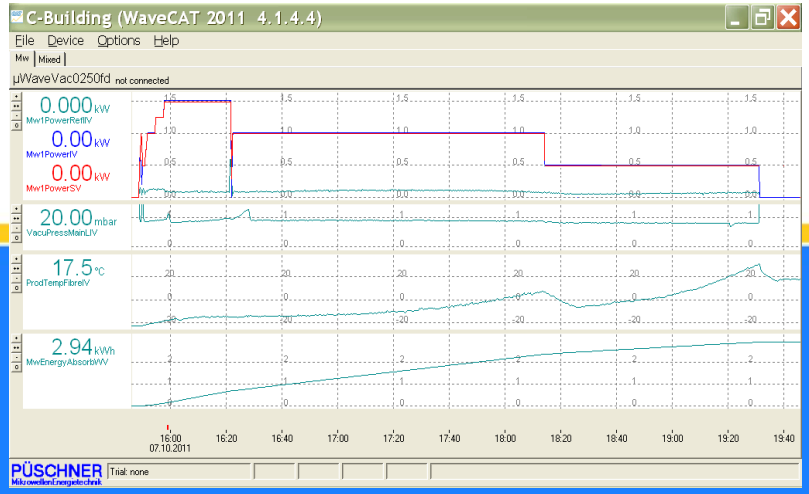
Mw FD of Raspberries in open Drum







Brix	8-13%
Initial Weight	3kg
End Weight	0.45kg
Drying Time	3,5h
Max Temperature	35°C
Applied Mw Energy	2,94kWh



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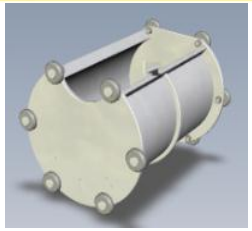
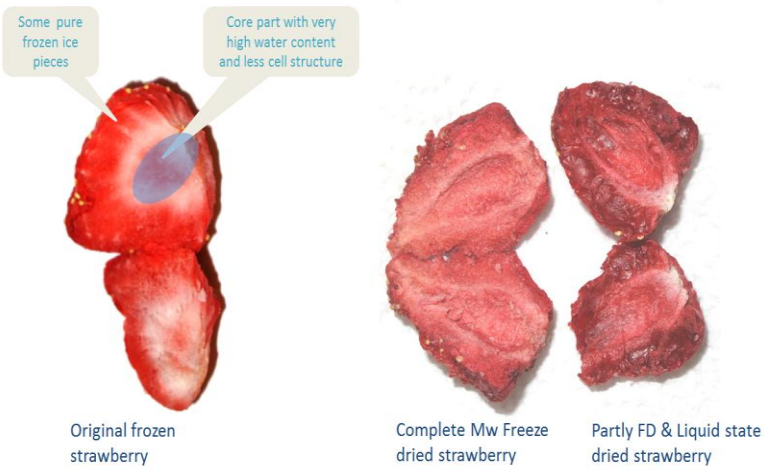
Mw FD of Strawberries in open Drum

- Homogenous Freezing of Fruits very important
- Fruits have to be calibrated





Initial Weight	3kg
End Weight	0.51kg
Drying Time	3,0h
Max Temperature	42°C
Applied Mw Energy	2,81kWh

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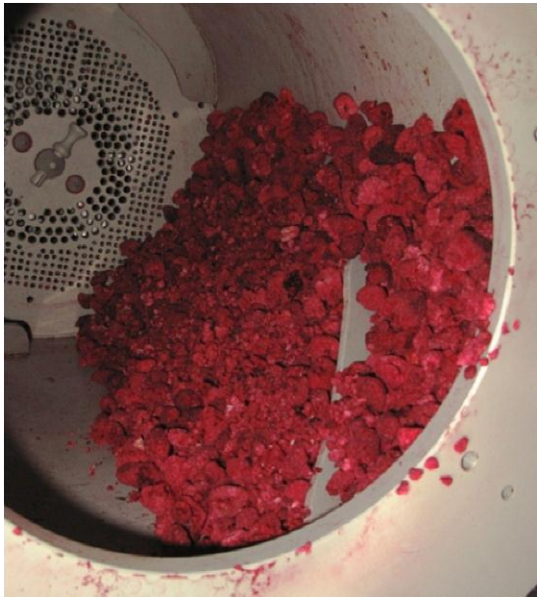
Mw FD of Raspberries in closed Drum



Brix	8-13%
Initial Weight	5kg (83% MC)
End Weight	0.82kg (7-10% MC)
Drying Time	3,4h
Max Temperature	35°C
Applied Mw Energy	4.64kWh

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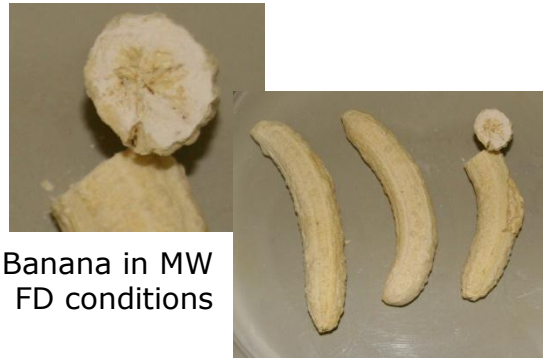
Further Application Examples

Strawberries in MW FD

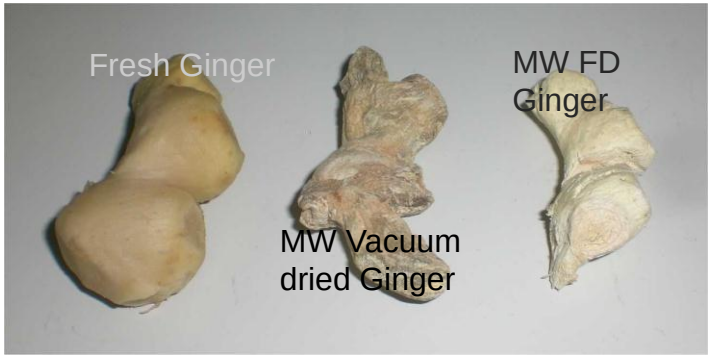
Broccoli in MW Vacuum Drying

Cranberries in MW FD conditions

Herbs in MW Vacuum Drying in fluidized bed conditions



Banana in MW FD conditions



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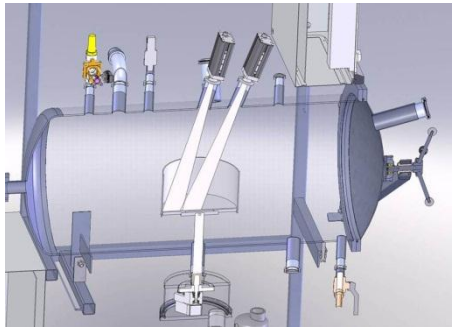
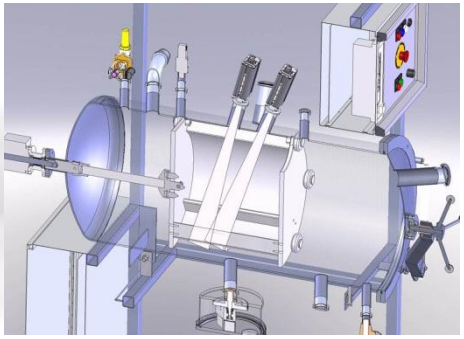
Microwave Freeze Drying of chemical Raw Material





Summery

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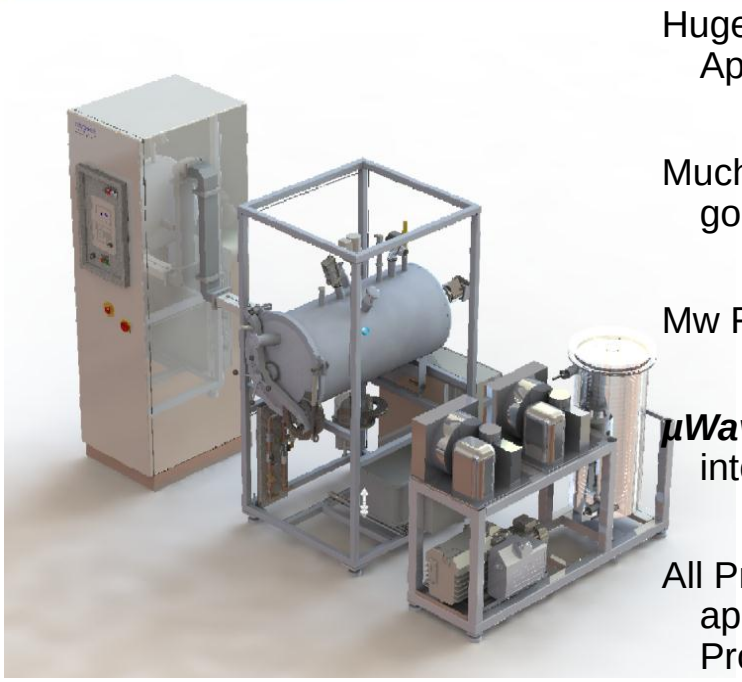

Huge Potential for Mw FD Technology in Food, BioTec & Pharma Applications

Much more shorter Drying times with better Quality Parameters gives good economical.

Mw FD Technology will develop with niche application.

µWaveVac xx50 offers Multipurpose Conditions and is ideal Entrance into Microwave Freeze Drying Technology

All Processes have to be proven before in small scale using an appropriate Micro-wave Concept which can be up-scaled later to Production Scale

Thank you for your attention

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