ANFD

Agitated Nutsche Filter Dryers

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Every day, PSL Agitated Nutsche Filter Dryers (ANFD) are assisting pilot and production facilities around the world to reliably manufacture and bring their products to the market faster.

Our technology is being used in commercial production in a wide range of industries including pharmaceuticals and fine chemicals, for sensitive and/or high value products.

PSL's full size Agitated Nutsche Filter Dryers isolate and wash solids in the most complex chemical and pharmaceutical synthesis processes and challenging production environments. Our solutions are designed to overcome well-known challenges faced by manufacturers when using traditional production methods.

Each of our filter dryers consists of an agitated vessel designed to work under vacuum and under pressure. The vessel can be made of either stainless steel (304L or 316L) or Alloy C22. It is also equipped with a heated jacket and heated agitator for efficient product drying and mixing.

Features and Benefits

- **Combined Filtration and Drying**
  Multiple process steps incorporated into a single piece of equipment
- **Agitator Efficiency**
  Specific agitator design for efficiency through each process step
- **Industry Compliance**
  cGMP design for pharmaceutical applications
- **Design Flexibility**
  Modular process features to meet process expectations
- **Batch Reproducibility**
  PSL software and automation package available
- **Containment-ready**
  Can be combined with containment isolators (flexible or rigid)
- **Scale-up Capability**
  Wide range of sizes from pilot to commercial production scale.

PSL's Agitated Nutsche Filter Dryer

1 - Top Driven Central Agitator

- Low speeds
- High torque

2 - Double Mechanical Seal

- Hygienic design
- CIP and SIP suitable

3 - Pressure Envelope

- Operates under pressure (filtration)
- Operates under vacuum (drying)

4 - Heating Zones

- Base, vessel jacket and agitator

5 - Agitator Height Adjustment

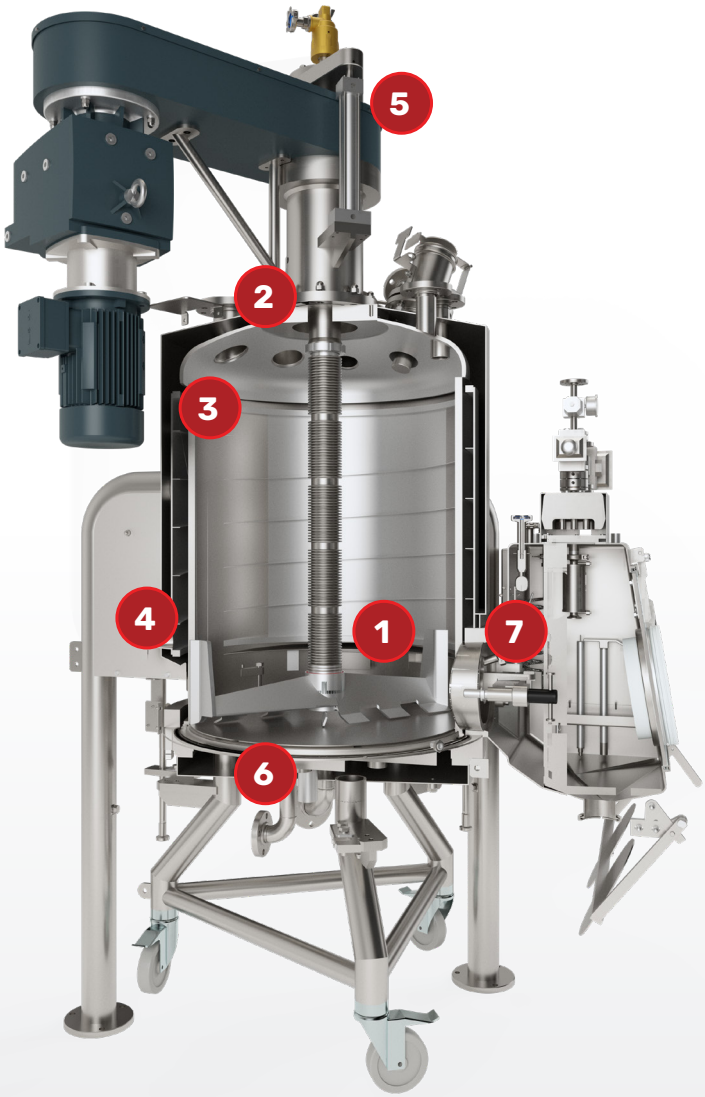
- Hydraulic raise/lower cylinders
- Compact hydraulic pack

6 - Filtering Element

- Metallic sintered mesh
- Filtering cloth
- Interchangeable design

7 - Discharge Plug

- Manual or automated
- Compatible with containment devices



Combined Filtration and Drying

PSL's versatile ANFD solutions combine all the processing steps within a single piece of equipment. Firstly, solid-liquid separation is carried out, also known as filtration. The next step often consists of washing the product to remove impurities and/or solvent traces. The final steps are to dry and collect the solids.

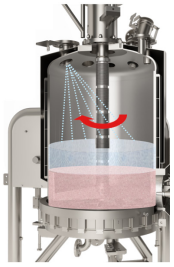
In the majority of cases the solid is the product of interest but filter dryer technology can also be used in processes where the filtrate (liquid) is the desired product. It is also possible to retain both the solid and the filtrate, if required.

Slurry Filtration

- Slurry is introduced via a nozzle on the lid of the vessel.
- The agitator, when in motion, assists filtration throughput. It can remain static if the product cake is used as filtering media.

Product Washing and Re-slurry

- Impurities within product cake can be washed with solvents introduced from the top nozzle or spray ring.
- The agitator is used to put solids back in suspension, also known as re-slurry washing.



Pressure Filtration

- Pressure gas used above the cake will remove excess liquid and moisture content.
- The agitator is used to smooth the cake.

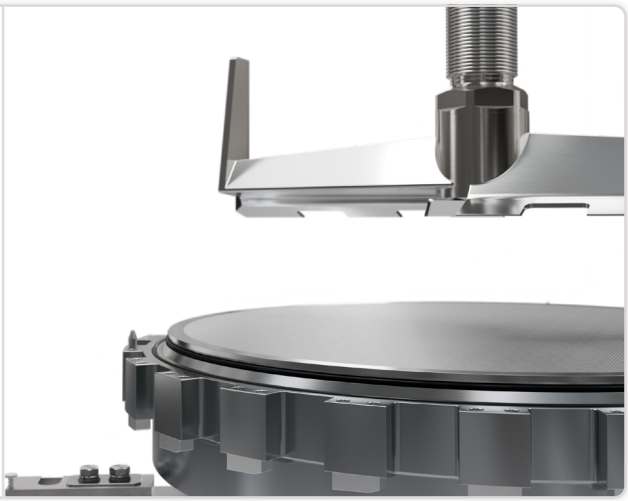
Vacuum Drying

- Lower boiling points of solvents are reached when the vessel is under vacuum.
- The agitator, when used at low rpm, and with raise/lower cycles ensures product drying uniformity.

ANFD Processing

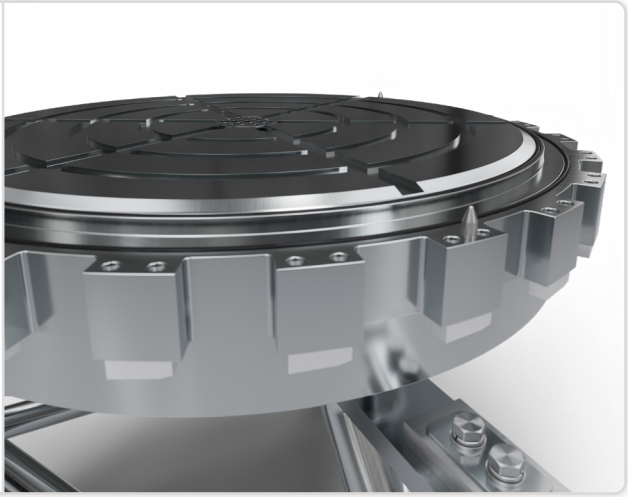
Agitator

- cGMP, single piece design
- Heating capability on larger sizes
- Straight tapered blades, with underside blades for added differential mixing
- Side fins at extremities to prevent sidewall build-up
- Double mechanical seal design, suited for use with HPAPI or sterile applications
- Metallic bellows for vessel pressure seal.



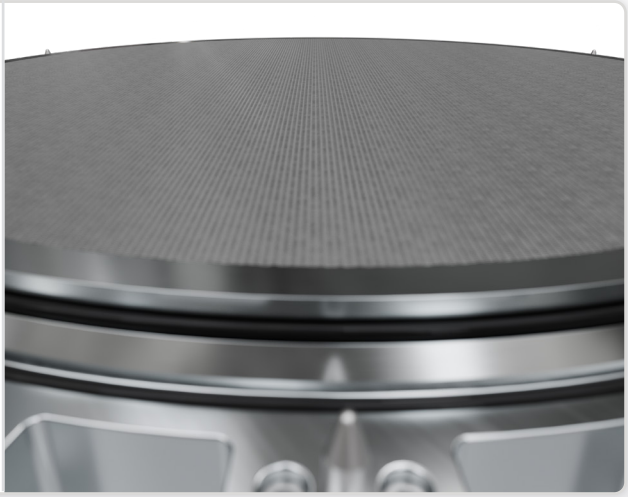
Flat Base Design

- Minimum liquid “dead volume” under the filter mesh (drainage channels), to reduce solvent waste
- Flat base design with jacket allows for direct heat transfer to product due to the energy efficient equipment



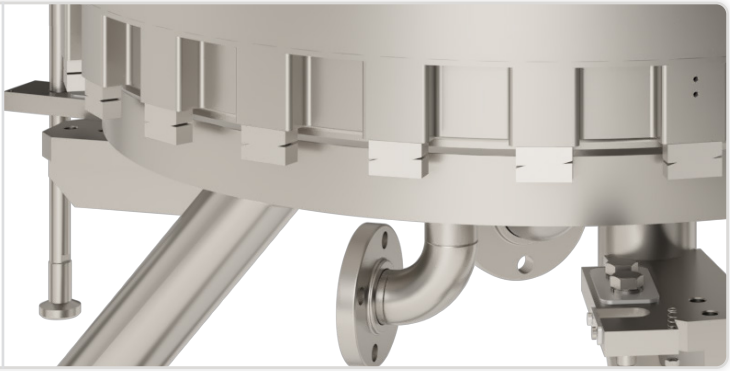
Versatile Filtering Media

- No screws or bolts required for fixing filtration element in place
- Design allows for interchangeable filtration media with either filtration cloth (using a support perforated plate on flat base) or metallic sintered mesh.



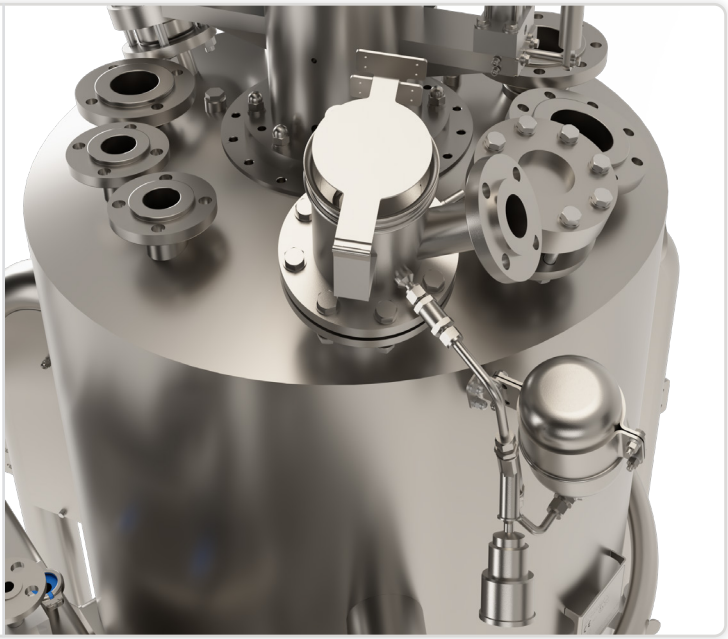
Base Automation Capability

- Economical pressure C-clamp design. Manually operated.
- Automatic hydraulic raise/lower with manual clamp/unclamp
- Fully automatic bayonet base (hydraulic raise/lower and hydraulic lock/unlock)



Dust Filter

- Protection of vacuum lines via filtering cartridge (metallic sintered mesh or cloth)
- Nitrogen pulse back feature to unclog the filtering elements if required
- Integral design to minimise headspace required on vessel top dome, including safe change feature



Cleaning

- PSL filter dryers incorporate an internal CIP ring with PTFE spray nozzles to provide fluid coverage to all internal areas, including process nozzles, agitator seal and bellows
- Reflux cleaning, controlling the independent heating zones on the vessel

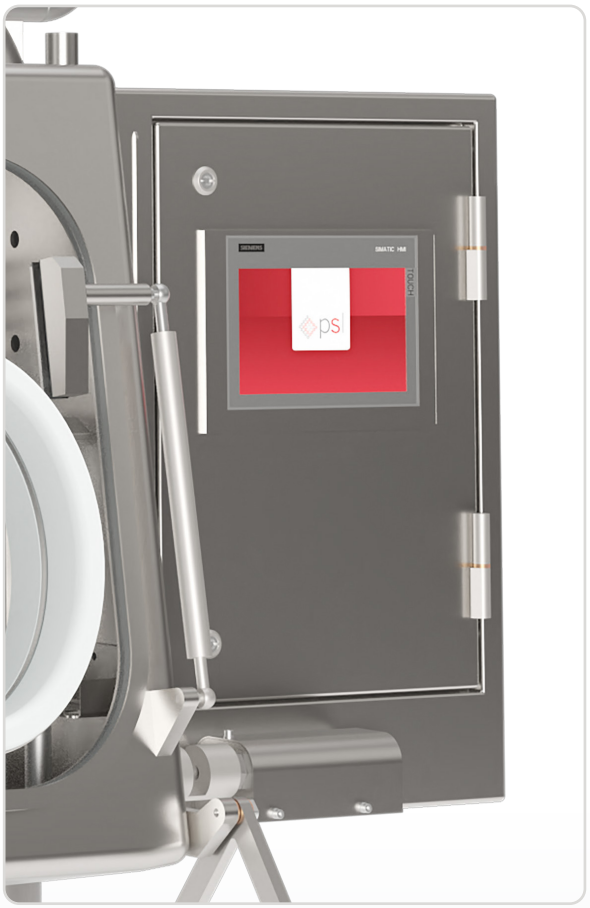
Automation and Compliance

Software Automation

PSL's ANFD range is available as stand-alone equipment for client/third-party integration or in combination with a PSL software and automation package.

Different levels of control/automation can be supplied to add speed and flexibility to manufacturing processes:

- Field instrumentation, wired to local junction boxes for client to integrate to their DCS (Distributed Control System)
- Basic PLC, HMI and software package for controlling ANFD with process exchange signals to client DCS
- Additional agitator sequence recipes; 10 steps for repeatability of agitator height, speed, direction and timer of your process



PSL complies with major international practices and regulations for software automation, including GAMP5 (Good Automated Manufacturing Practice, version 5 by ISPE) and 21 CFR Part 11 established by the US FDA for electronic records and signatures.

Industry Regulations and Chemical Compatibility

- Hazardous Area Compliant: Rating for vessel internals down to Zone 0/20 (ATEX) / Class 1 Div 1 (NFPA)
- Pressure Directives: PED, ASME "U" Stamp, SELO, etc
- 304L Stainless Steel, 316L Stainless Steel or Alloy C22 vessel material of construction
- Multiple sealing elements and elastomer grades: EPDM, FKM, FFKM, PTFE, etc

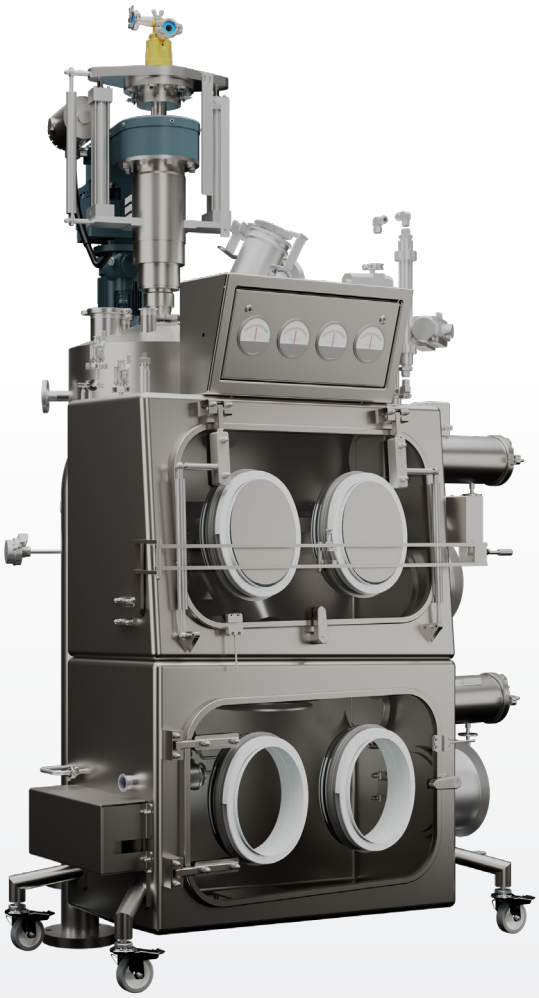
Containment

Many industrial filtration and drying processes require the integration of containment technology to protect operators from highly toxic compounds and/or to protect sensitive products from a harmful production environment.

Although the filtration and drying phases within an ANFD require no physical operator intervention, in certain circumstances unloading the product can remain manual.

If the end product is potent/toxic or oxygen sensitive, as it is often the case within pharmaceutical applications with an Active Pharmaceutical Ingredient (API) or Highly Potent Active Pharmaceutical Ingredient (HPAPI), a containment solution is necessary.

Automated discharge exists, but this will result in a product heel being left on the mesh. In this instance, particularly with the high value of the required end product, the highest yield can only be achieved by manual intervention, via the rake and recovery approach.



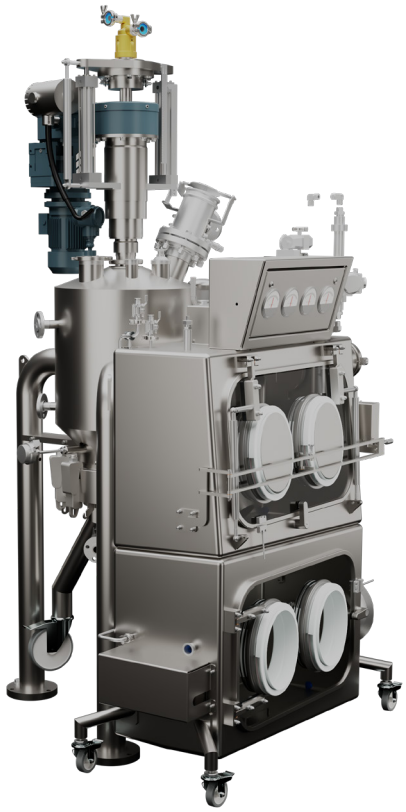
Flexible Containment

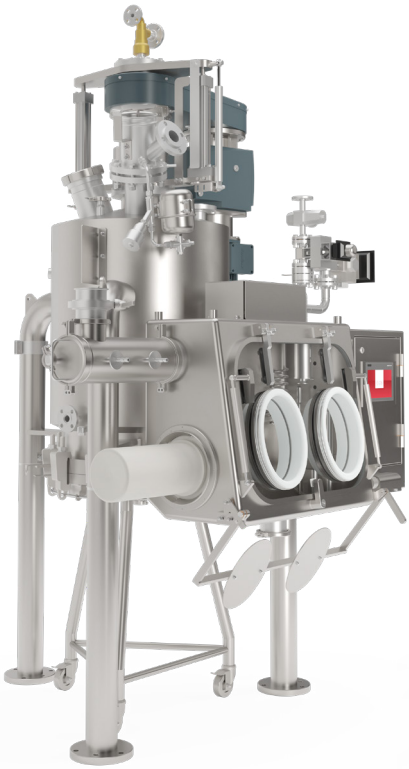
- For containment requirements down to OEB4 products (<10µg/m3), a flexible solution can be used as it is disposable (less cleaning for multi-products or contract manufacturing)

Rigid Containment

- For higher containment requirements down to OEB5 products, nanogram/m3 level containment is available
- Single or double chamber configurations can be assessed, depending on batch sizes and containment performance requirements.
- Various product packaging solutions can be adapted: continuous liner, containment valves (split valves), rapid transfer ports

ANFD Range





Filter Dryer Configurations					
Nominal Filtration Area Size	0.05	0.125	0.3	0.6	1.0
Typical Operating Liquid Volume (L)	25	110	270	550	900
Recommended Min/Max Cake Volume (L)	1 / 10	6 / 38	15 / 120	30 / 240	50 / 400
Recommended Min/Max Cake Thickness (mm)	25 / 200	50 / 300	50 / 400	50 / 400	50 / 400
Vessel Operating Temperature Range (°C)	-25 / 200	-25 / 200	-25 / 200	-25 / 200	-25 / 200
Vessel Operating Pressure Range (barG)	FV / 4	FV / 4	FV / 4	FV / 4	FV / 4
Mobile Version Available	Yes	Yes	Yes	*	*
Suitable for Hazardous Area (ATEX, NFPA)	Yes	Yes	Yes	Yes	Yes

*Other configurations available upon request.

Successful Scale Up

The GFD® Family is perfectly suited to complete scale-up and scale-down studies as it helps maintain key objectives such as product quality, product yield and batch consistency, along with the key production parameters of filtration time, washing time and drying time etc.

The GFD® product range is designed to streamline scale-up development from early R&D activities (GFD®Lab) and GLP batches up to Pilot Plant production (GFD®Pilot).

GFD®

R&D and Pilot Filter Dryers

- Evolutive sizes for filtration area:
  - GFD®Lab with 0.002m² and 0.01m² (010 and 050 Series)
  - GFD®Pilot with 0.05m² (500 Series)
- Unique removable filtration basket concept with various mesh material and porosity options
- Glass vessel configurations. Advanced metallic (316L Stainless Steel or Alloy 22) version available
- Various product contact material options for process versatility and chemical compatibility
- Designed for seamless integration to lab benchtop or fume hoods configurations

Taking your process further, together.

For over 35 years, Powder Systems Limited (PSL) has been at the forefront of designing and engineering advanced technology to support process development. We are a globally recognised, award-winning business with expertise in pharmaceutical and chemical processing.

Our focus is to help clients and partners address challenging manufacturing processes by providing fit-for-purpose solutions from our wide range of Microsphere Processing, Filtration and Drying ranges.

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