

# Technical Specification

## Pilot/Production Scale Continuous Carousel Filter Dryer AWL CCFD50 Vision

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## Overview:

### **System:**

The AWL Continuous Carousel Filter Dryer "CCFD" has been designed to produce filtered, washed and dried products in a continuous manner. The core technology is based on well-established Nutsche filtration, processing thin cakes in a fully automated system. The carousel is a series of hollow cylinders moved around a central axis to fixed processing stations. The CCFD50 Vision has an onboard vision system which monitors cake and liquid levels allowing fine control over filtration and washing, improving purity, yield and quality attributes. The vision system also enables the processing of slurries with 'non-settling' particles, or particles with a prolonged settling time. The CCFD is supplied complete with all valves, pumps and vessels to allow for fully continuous operation, the user merely needs to connect their vacuum and compressed air supplies and drying gas supply if required.

The standard supply consists of a support structure with the following main components; slurry buffer tank, solvent wash tank (x2), wash solvent pumps (x2), Wash-in-Place "WIP" tank, WIP pump, combined carousel filter/dryer, camera vision system, filtrate receiver (x1), drying solvent/WIP Receiver, filtrate sampling bottles, solids discharge chute terminated with a tri-clamp outlet flange, and a PLC / touch screen control system. The filter carousel consists of ten 50 mm diameter, 400 ml capacity filtration chambers. The carousel and filter base have been designed to be easily removed for thorough manual cleaning if required.

This system is designed for use in a safe area and is not suitable for an ATEX environment.

### **Carousel Filtration and Drying:**

The DN50 CCFD Vision is a pilot/production scale continuously operating filter dryer. It is capable of automatic filtering, washing (with two different solvents), deliquoring, drying and discharge of filtered dry solids. Integrated wash-in-place (WIP) is included. Solid-liquid separation is by means of vacuum over a sintered multilayer filter plate. Industrial standard multilayer filter plate material is available in various micron ratings, from 2 to 40 microns. The system operates by individual controlling filtration and washing in each port simultaneously. The camera vision system detects the cake and liquid levels allowing the filtration and washing to stop at or near to dryland. Drying is achieved through a heated nitrogen system.

### **Warm Nitrogen Drying:**

The flow and temperature of the drying gas is controlled using the following:

- N<sub>2</sub> heated by AWL's electric heated transfer line technology
- Maximum jacket temperature 100°C
- PID loop control
- Inlet & outlet temperatures measured by K-Type thermocouples (displayed on HMI)

### **Vision System:**

The system is supplied with a high-resolution camera and lighting system used to monitor the cake and liquid levels with a resolution of 5 ml. The system can detect dryland, to allow filtration and wash draining to stop at or just before dryland. Wash solvent volumes are monitored to automatically dispense wash volumes calculated from the measured cake height. This allows for fine control of filtration and washing parameters to maximise yields and purity. The cake is not fully de-liquored until washing is complete, thereby avoiding cake cracking and increasing wash efficiency.

## Functionality:

All automatic functions are recipe controlled via the HMI touch screen and can be adjusted to suit different chemistries.

The following functions are included in the supply:

- Auto wash, filter and drying cycle
- Auto transfer function from external reactor/crystalliser
- Auto wash solvent dosing systems (x2)
- Auto WIP dosing system
- Vision system for fine control over filtration and washing
- Ability to process 'settling' or 'non-settling' slurries
- Heated Nitrogen/Air drying with temperature control
- Filtrate receiver and WIP Receiver with auto-drain feature
- Selectable wash contact time for diffusional washing
- Filtrate sampling bottles for offline analysis of filtrate
- Auto data population, recall and presentation
- Auto WIP sequence
- End-of-Day automated cleaning routine

## Process Sequence:

First, the slurry is transferred from the jacketed, agitated buffer vessel into a charge vessel via vacuum transfer. The slurry volume is then dispensed into the first port of the carousel. The carousel rotation is controlled by a servo motor which indexes the carousel ports to fixed processing stations. The process sequence for each port position is as follows:

- Port Position 1: Solid-liquid separation stopping before dryland
- Port Position 2: 1<sup>st</sup> Wash, either Solvent 1 or 2. Stops drain before dryland
- Port Position 3: 2<sup>nd</sup> Wash, either Solvent 1 or 2. Stops drain before dryland
- Port Position 4: 3<sup>rd</sup> Wash with either Solvent 1 or Solvent 2 and deliquor
- Port Position 5-9: Drying via heated nitrogen or air
- Port Position 10: Cake Discharge

Wash Solvent 1: Removes Impurities

Wash Solvent 2: Solvent exchange, for instance to reduce drying time or agglomeration

## Modes of Operation:

- Optimisation Mode: Processing in optimisation mode allows one aliquot to be automatically processed in the system. Once the filtrate and solids are analysed (offline), the process can be adjusted to achieve the optimised washing, filtration and drying with minimal input material. On completion, the operating parameters can be saved to a recipe for use in production mode.
- Production Mode: Maximum throughput operation including automatic solid-liquid separation, dosing of wash solvents and drying
- Manual Mode: All valves, pumps and operations can be controlled manually via the touch screen control panel
- Auto calibration features: Slurry transfer volume, camera calibration, cake height calibration for 'non-settling' slurries
- End-of-Day WIP: The filter internals can be cleaned by an automated wash-in-place sequence which sprays the carousel filter using the WIP pump system. The filter system is flooded and drained to remove residual material.

### **Interfacing with upstream processing:**

The filtration system is designed to accept slurry from a batch or continuous source. It can operate as a stand-alone unit or interface directly with a reactor or crystalliser. Valves are included within the standard scope of supply to allow auto-transfer in from an upstream process. Transfer volumes and intervals can be specified by the end user.

### **Process Vessels:**

The following process vessels are provided with the system.

- 2 Litre capacity jacketed, agitated slurry buffer vessel
- 450 ml capacity jacketed slurry dosing vessel
- 2 Litre capacity Wash Vessels (x2) complete with peristaltic pump
- 2 Litre capacity WIP Vessel complete with peristaltic pump
- 3.5 Litre capacity Filtrate Receiver vessel
- 3.5 Litre capacity WIP Receiver vessel
- 2 Litre solids receiver bottle (supplied with solids discharge adapter to attach bottle)
- 0.5 Litre pressure rated laboratory bottle for filtrate sampling (x5)

Vessels are manufactured from borosilicate 3.3 glass.

The 3.5 L capacity receiver vessels act as a buffer for the filtrate and wash waste from the system. The auto drain sequence is managed by the onboard control system. It is the end user's responsibility to connect the receiver outlets to the appropriate waste/collection stream.

### **PLC / Control System:**

The control system consists of a pre-programmed PLC system, 9" touch screen, safety circuits and power isolator. Controls are enclosed within the framework of the Carousel Filter Dryer and the HMI touch screen is housed in a separate Local Operating Panel. DCS remote access / control is available.

### **Support Structure:**

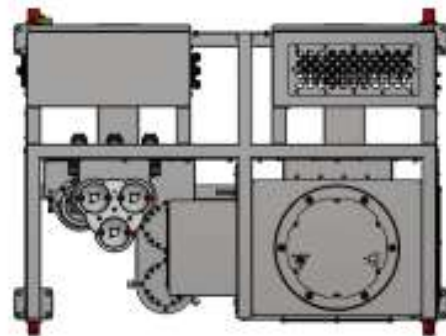
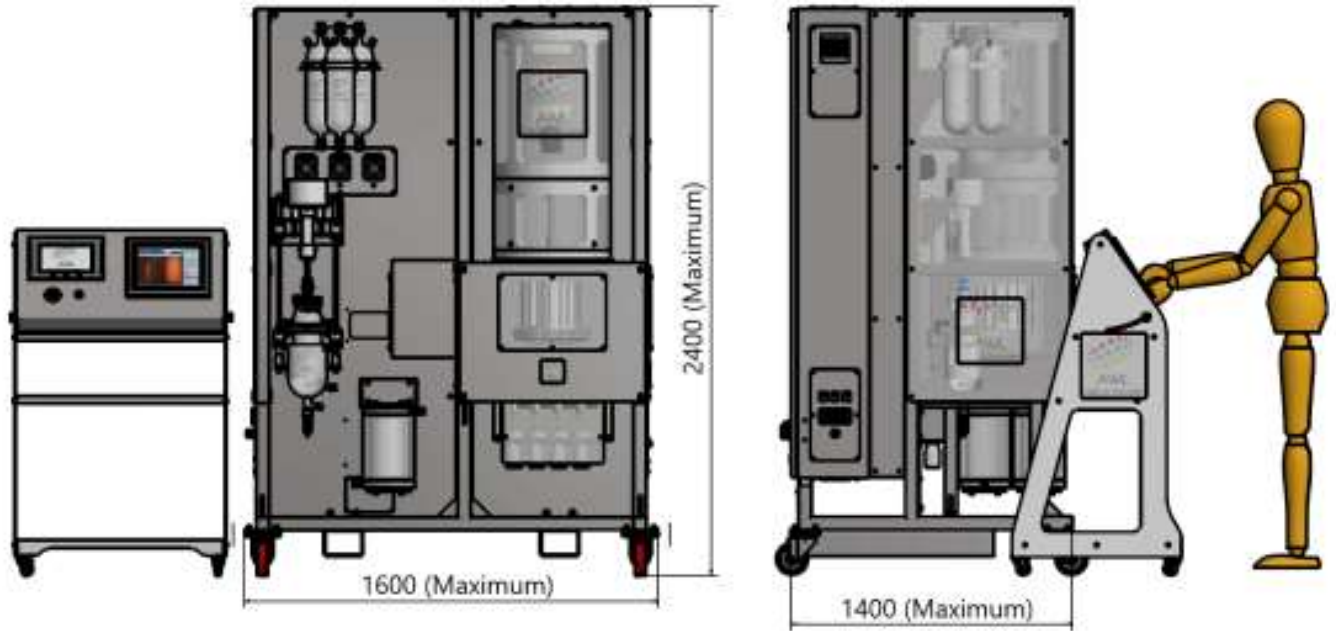
The CCFD and process vessels are mounted on a self-supporting 304 stainless steel mobile framework and mounted on four castors. Utility connections (compressed air, vacuum, nitrogen(optional), electrical supply) are provided on the rear of the structure.

### **Overall Dimensions / Weight:**

Approximate Weight: 825 kg (complete system)  
Dimensions: 1600mm Wide x 1400mm Deep x 2400 mm High

The above dimensions are the footprint of the filter unit.  
Minimum of 1700 mm x 1500 mm advised to allow for connection of services.

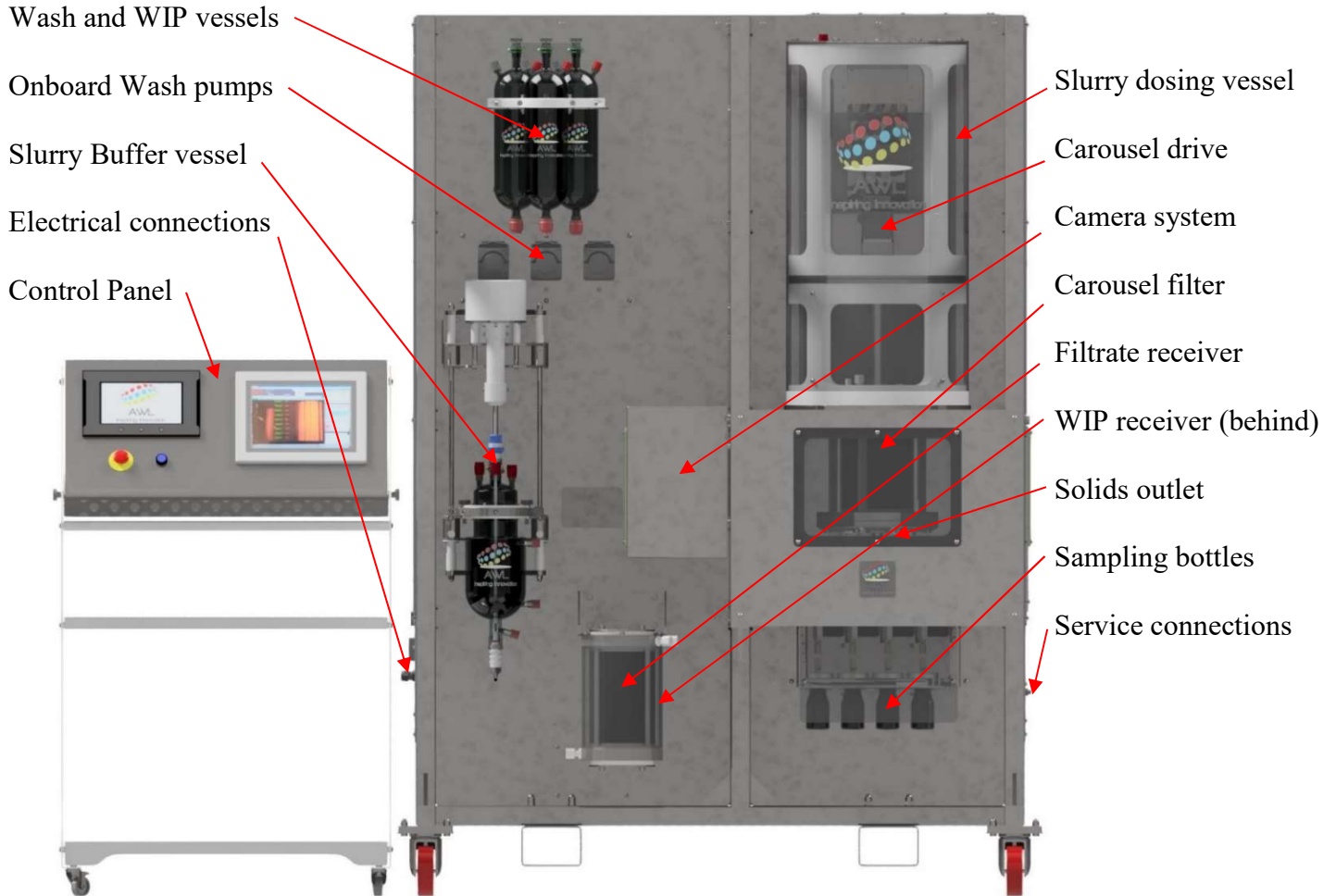
## General arrangement of the CCFD50 Vision



Representative Arrangement of a CCFD50 Vision Filter Dryer



## System Configuration



**Typical configuration of a CCFD Vision**

## Process Section - Operating Parameters & Design Criteria:

### Filter:

Temperature Range:	-20°C to +100°C
Design Pressure:	-1.0 bar to +50 mbar
Material of Construction:	Wetted parts - 316L, PTFE, Polypropylene, PEEK, FEP, Borosilicate 3.3 Glass
Filter plates:	Sintered Mesh 20 micron, 5 layer, 316L (alternative size and material available on request)

### Process Vessels:

Temperature Range:	-20°C to +100°C
Design Pressure:	-1.0 bar to +50 mbar
Material of Construction:	Borosilicate 3.3 Glass

### Process Valves and Pipe work:

Process Valves:	Wetted parts: PTFE / PEEK, FFKM, 316L
Pipe work:	FEP, PTFE
Fittings:	PFA, PTFE, Polypropylene, 316 L

### Typical flow rates:

Typical Slurry flow rate:	From 15 l/hr to 30 l/hr slurry (Chemistry dependent)
Typical Solids throughput:	From 3 to 6 kg/hr dried solids (Chemistry dependent) (Based on 20% Solid Loading)

### Service Requirements:

Electrical Specifications:	1 phase, N and Bonded Earth, 230 Volts, 50 Hz, 16 Amps (local geographical variations to be discussed)
Compressed Air specifications:	4-6 bar compressed air @ 10 l/min
Vacuum Specifications:	2 independent vacuum supplies capable of >900 mbar vacuum. One with 500 L/min flow rate, one with >20 L/min flow rate, both with condenser or solvent compatible pump.
Nitrogen Specifications:	550 L/min in production mode (depending on drying and filterability of processed material)

All Utility connections are provided on the side of the structure.

**NOTES:** - All pressures in this document are stated as bar gauge  
 - Flow rates are chemistry dependent  
 - Carousel is not actively cooled; filtration, washing, de-liquoring take place at ambient temperatures  
 - Alternative wetted parts can be made available to suit user chemistry

## Documentation Pack:

Each filter is supplied with two sets of documents (one hard and one electronic) consisting of the following:

- Operation and Maintenance manual
- Engineering Drawings / Parts Lists
- Electrical Schematics
- OEM manuals for non-proprietary equipment
- Declaration of Conformity
- Safety documentation

## Standards and Directives:

As a minimum all of the AWL Carousel Filter range are designed and built to meet the following standards, others are available on request:

2014/35/EU:	Low Voltage Directive
2014/30/EU:	Electromagnetic Compatibility Directive
EN 13849-1 : 2015	Safety of Machinery – Safety related parts of control systems
EN ISO 12100 : 2010	General principles for design. Risk assessment & Risk Reduction
EN 61000-6-4 : 2007	Generic Immunity Standard – Industrial Environment
EN 61000-6-6 : 2003	Generic Emission Standard – Industrial Environment

## Options:

The following options can be added to the unit if specified at time of order:

- Nitrogen Blanket System: Includes low pressure regulator and valves to control nitrogen blanketing.
- Materials of construction: Various available, particularly wetted parts
- Dosing of slurry via tube-in-tube temperature-controlled transfer line. Available as stand-alone product.
- Dosing of wash solvent via a liquid/liquid heat exchange ensuring that wash solvents are cool on arrival at the carousel filter.
- DCS control via OPC server
  - Provision is made for remote control and access to the relevant process information via a communication module. Our standard communication is achieved by using an OPC Server (KEPServer). All process related signals, readings and data are accessible. Remote access to functions is limited to those deemed safe to operate without the presence of an operator at the filter operating panel.

**For further information:**  
**please contact:** [enquiries@a-w-l.co.uk](mailto:enquiries@a-w-l.co.uk) **or visit:** [www.a-w-l.co.uk](http://www.a-w-l.co.uk)