Drying Methods and Processes

Samples Types and Preparation

Size of the sample and its preparation shall provide the following: sample structure homogeneity, short time of drying, good repeatability of measurement within a measurement series and drying process result comparable to a reference result (standardised method).

Solid bodies
- light sample,
- requires grinding

Samples of low humidity
- heavy sample
 (10 - 15 g)

Liquids
- increasing active surface of evaporation is recomended

Sample Structure Transformation

Unfavorable physical processes, affecting the sample structure, may occur during the drying process. These are caused by dispersion of indications and mistakes made when undertaking assessment of actual moisture content for a particular sample.

Crust Formation
It is a process where an impermeable layer is formed on a sample surface. This makes removal of humidity from the sample impossible. As a result the indication being an outcome of an analysis is lower than the sample reference value.

Sample Burning
Such a process is a consequence of too high drying temperature. it results in a change of sample colour. When sample burning occurs then the sample humidity value is greater than its reference value.

Heat Absorption
Dark in colour samples absorb more heat than the light ones. this accounts for application of lower drying temperatures while drying light in colour samples. Tests need to be carried out in order to select the right temperature value.

Automatic Control of Sample Weight

Obtaining optimal results for a drying process depends on samples quantity and weight. Too heavy sample lengthens duration of the drying process. Too light sample works against repeatability of the results. This proves that control of the sample weight is inevitable.

A WEIGHT CONTROL (checkweighing thresholds)

B GRAPH (drying process curve, registered for dynamic state)

C DRYING PROGRAMS (drying mode type, temperature, auto switch-off)

D SAMPLES (name, code, end mass, tolerance, etc.)

E SAMPLE DESCRIPTION (information on how to prepare a sample for a drying process)

Initial mass	2.7548 g
0:00:10	0.1503% M
0:00:20	0.6258% M
--------- Auto switch off ---------	
0:08:08	Auto 1
Result	11.4789% M
--------- Auto switch off ---------	
0:11:05	Auto 2
Result	11.9058% M
--------- Auto switch off ---------	
0:13:55	Auto 3
Result	12.0502% M
--------- Auto switch off ---------	
0:15:20	Auto 4
Result	12.0858% M

Demonstrative printout of TEST function.

Methods of Analysis Completion

TEST function analyses weight variation for a particular sample, occurring during the drying process. There are 5 different options for automatic shutdown. the user shall select option allowing him to end the drying process in a way ensuring that the obtained humidity value is as close as possible to a reference value. Among other automatic shutdown possibilities there are time-defined, manual and user-defined options, the latest one being the best adjusted to a particular sample characteristics.

Obtained humidity value depends on start mass of a particular sample – an optimal mass value shall be selected prior running the tests.

Respective method for a particular sample drying, shall be selected based on tests optimizing the sample size, drying temperature and method of analysis end procedure.

Reports and Statistics

Report on Drying Process

RADWAG moisture analyzers allow the user to make self-configured reports. Analysis, summaries, etc. may be printed by means of any office printer (PCL).
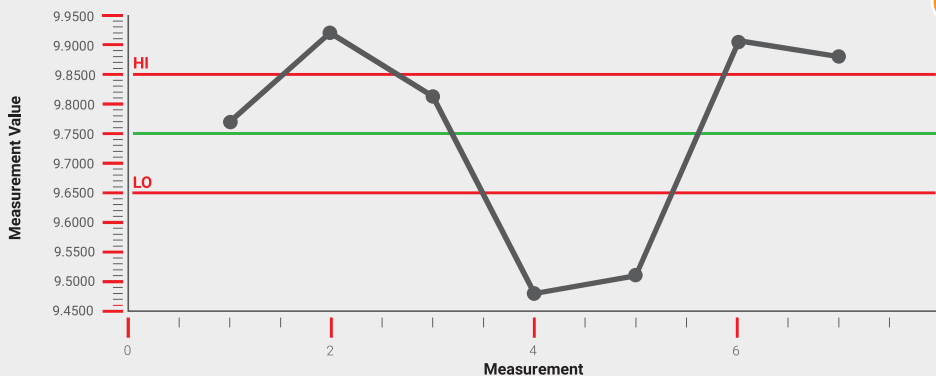
The report comprises three sections: the header (A), the data area (B) and the footer (C). Each section can be freely configured by a user.

Drying Process Statistics

Moisture content analyses performed for the same sample are used to determine the sample moisture content variation within a specified time interval (Trend).

```
----------- Drying ------------
Date                    05.01.2021
Time                       6:32:18
Operator                     Admin
Product                    Prod-01
Program                      MAR-1
Drying profile            Standard
Drying profile parameters     90 °C

Finish mode                 Manual
Start mass                  0.674 g
----------------------------------
0:00:30
0:01:00
0:01:30
0:02:00
0:02:30
0:03:00
----------------------------------
Status                   Completed
Drying time                0:03:00
End mass                    0.499 g
Result                  25.964% M
----------------------------------
```

Example of a simple drying report, generated by MA R moisture analyzer.

Trend graph is calculated automatically. Calculating moisture content variation is required wherever manufacturing process and control is performed in a permanent manner. the obtained data is used by systems controlling the manufacturing process. it helps to determine optimal moisture content for a particular sample, required for a finished product prior its packing.

```
----------- Drying ------------
Start date              2021.01.28
Start time                11:34:44
Operator                     Admin
Product                       Corn
Drying mode            Corn-PRG01
Drying mode               Standard
Drying mode parameters      100 °C
Auto switch-off mode          Auto
Finish mode parameters    1 mg/60 s
Printout interval          0:00:30
Start mass                  0.590 g
----------------------------------
Date and time    2021.01.28 11:35:14
Drying time                0:00:30
Product                       Corn
Current result           5.085% M
0:00:30                   5.085% M
Humidity content         5.085% M
Dry mass content        94.915% D
Humid / Dry              5.357% R
Tare                        0.007 g
Gross                       0.567 g
Set temperature             100 °C
Current temperature          99 °C
----------------------------------
Date and time    2021.01.28 11:35:44
Drying time                0:01:00
Current result           7.795% M
----------------------------------
Date and time    2021.01.28 11:39:14
Drying time                0:04:30
Current result          14.237% M
----------------------------------
Status                   Completed
End date                2021.01.28
End time                  11:39:22
Drying time                0:04:38
Operator                     Admin
Product                       Corn
End mass                    0.506 g
Humidity content        14.237% M
----------------------------------
```

Example of a complex drying report, generated by PMV 50.5Y moisture analyzer.

Databases Managing and Editing

Databases
Drying Process Ergonomics

Drying parameters such as temperature and automatic shutdown are optimally selected for every single sample. Trying to remember the parameters for just a few samples requires considerable effort. it is more convenient to record the parameters in a database than attempting to learn them by heart.

Product Database
Contains any Data
Relating to a Sample:

• name and description,
• EAN code: searching a sample in a database by means of a scanner,
• target value (%): value used for automatic control of sample weight (bar graph) and for determining moisture content variation over time (trend),
• Min, Max: value used for automatic control of sample weight (bar graph),
• tolerance: value used for determining moisture content variation over time (trend),
• drying program.

Drying Programs Database
Contains any Data
Relating to a Drying Process:

• name, code,
• drying mode, drying temperature,
• automatic shutdown (auto / time-defined / user-defined),
• start mass control (none / optional / essential),
• equipment intended for a sample (methodology),
• instruction on sample preparation for a drying process (methodology),
• required sample size (methodology).
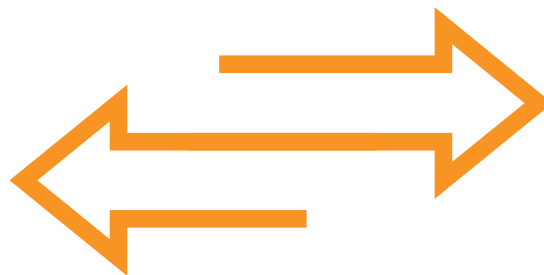
Database
Editor

Database Editor PC software is designed to support users dealing with a vast number of samples. Clear structure of the program ensures quickness when it comes to specifying drying parameters and other information relating to a sample. Data is transferred from the software to a moisture analyzer by means of Ethernet () or RS 232 (, R).

Available databases: Products, Weighing Records, Customers, Drying Programs, Drying Process Records, Ambient Conditions, Packaging, Warehouses, Printouts, Universal Variables.

Detailed information concerning the product.

Export / import of databases moisture analyzers

E2R Results Analysis

Databases Drying Processes Ergonomics

Production processes for which moisture content of a particular sample is a crucial parameter, require quick reaction. This may be carried out using so called weighing networks comprising PMV 50 PLUS, MA X2 and MA R moisture analyzers. Each drying process is monitored on-line regardless of workstations location.

E2R Moisture Analyzer PC software is designed to record measurements performed by means of RADWAG moisture analyzers cooperating in a network, using RS 232 and Ethernet interfaces for connection. the software enables monitoring and reporting of collected measurements.
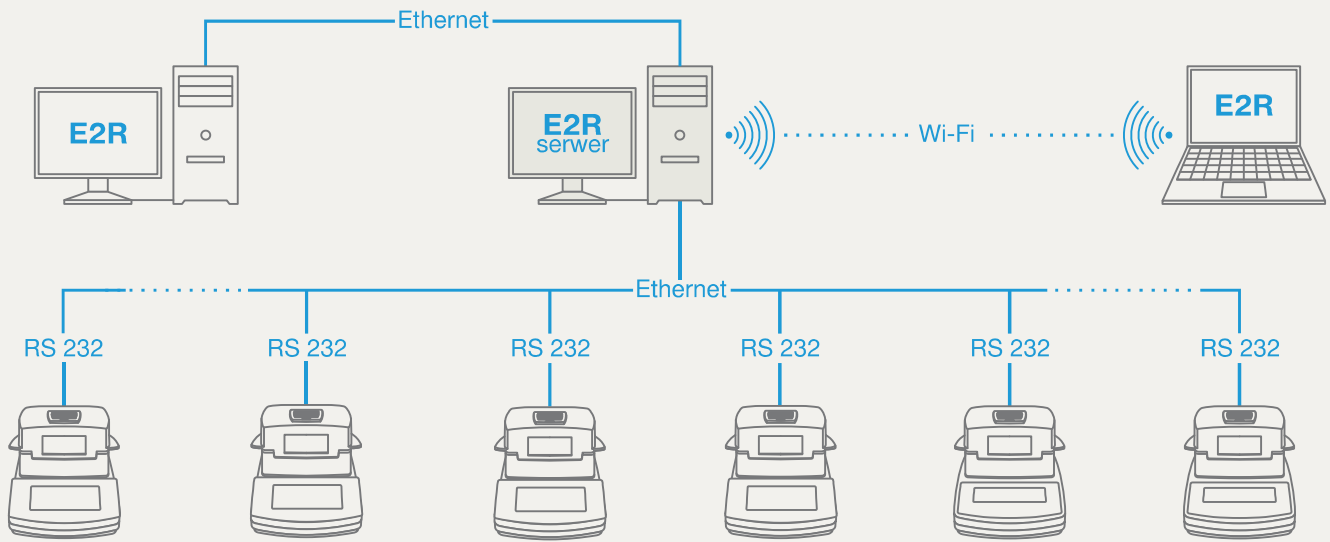
Software functions: on-line monitoring of moisture analyzer operation, possibility of configuring reports and graphs,analysis of data collected from many drying workstations, data protection.

PC Software

RADWAG PC software supports moisture analyzers expanding their functionality.

R-Lab
Scales preview, weighings graphs and statistics graphs.

Database Editor
Readout, databases editing and record of computer stored databases on balance.

Rad Key
Readout of balance data by means of defined Hot Key.

E2R Moisture Analyzers
Record of weighments carried out by moisture analyzers cooperating in a network.

Additional Equipment

- Anti-vibration weighing tables,
- Disposable weighing pans,
- Thermal and dot matrix printers,
- Barcode scanners,
- Control thermometer,
- Water vapor permeability set.

Complete offer is to be found on www.radwag.com website.

E2R Moisture Analyzer is a module of integrated system for managing E2R weighing processes. E2R System comprises various programs ensuring continuous control of balances and their databases together with both, complete managing of the manufacturing process and the process optimisation.

Intended Use and Aplications

Area of Use

Moisture content analysis and dry mass measurement of a particular product are both crucial for various branches of industry and science. Vast area of use and diversity of analyzed samples structure require individual approach to different substances.

Dairy Industry

Samples:
cheese, buttermilk, yoghurt, powdered milk, etc.

Samples are dried directly on a weighing pan or by means of glass fiber filters or silica sand (increasing surfaceof evaporation).

Fruit and Vegetable Industry

Samples:
dried vegetables, fruits and mushroom, nuts etc.

Samples shall be cut into smaller pieces (the analyzed samples cannot be too thick).

Food Industry

Samples:
sugar, flour, pasta, spices, gelatin, etc.

Thin layer of semi-liquid samples shall be distributed on a weighing pan (silica sand or glass fiber filters may be used). Other kinds of samples shall be crushed.

Chemical Industry

Samples:
emulsion, gel and lotions used for cleaning, paints, film, graphite, etc.

Thin layer of semi-liquid samples shall be distributed on a weighing pan (Silica sand or glass fiber filters may be used). Other kinds of samples shall be crushed.

Agricultural Industry

Samples:
grain, seeds, hay, biomass, etc.

Grain needs to be crushed prior drying.

Technical Specification

Microwave Moisture Analyzer

Product Code	Model	Max. capacity	Readability	Heating module
WL-307-0006	**PMV 50.5Y**	50 g	0,1 mg	microvawe radiation emiter

X2 Series

Product Code	Model	Max. capacity	Readability	Heating module
WL-306-0032	**MA 50.X2.A.WH**	50 g	1 mg	halogen
WL-306-0043	**MA 50.X2.IC.A.WH**	50 g	1 mg	halogen
WL-306-0035	**MA 50/1.X2.A.WH**	50 g	0,1 mg	halogen
WL-306-0047	**MA 50/1.X2.IC.A.WH**	50 g	0,1 mg	halogen
WL-306-0021	**MA 50.X2.A**	50 g	1 mg	IR emitter
WL-306-0041	**MA 50.X2.IC.A**	50 g	1 mg	IR emitter
WL-306-0026	**MA 50/1.X2.A**	50 g	0,1 mg	IR emitter
WL-306-0045	**MA 50/1.X2.IC.A**	50 g	0,1 mg	IR emitter
WL-306-0063	**MA 50.X2.A.NS**	50 g	1 mg	metal heater
WL-306-0074	**MA 50.X2.IC.A.NS**	50 g	1 mg	metal heater
WL-306-0075	**MA 50/1.X2.A.NS**	50 g	0,1 mg	metal heater
WL-306-0076	**MA 50/1.X2.IC.A.NS**	50 g	0,1 mg	metal heater
WL-306-0034	**MA 110.X2.A.WH**	110 g	1 mg	halogen
WL-306-0051	**MA 110.X2.IC.A.WH**	110 g	1 mg	halogen
WL-306-0027	**MA 110.X2.A**	110 g	1 mg	IR emitter
WL-306-0049	**MA 110.X2.IC.A**	110 g	1 mg	IR emitter
WL-306-0080	**MA 110.X2.A.NS**	110 g	1 mg	metal heater
WL-306-0081	**MA 110.X2.IC.A.NS**	110 g	1 mg	metal heater
WL-306-0078	**MA 200/1.X2.A.WH**	200 g	0,1 mg	halogen
WL-306-0065	**MA 200/1.X2.IC.A.WH**	200 g	0,1 mg	halogen
WL-306-0061	**MA 200/1.X2.A**	200 g	0,1 mg	IR emitter
WL-306-0062	**MA 200/1.X2.IC.A**	200 g	0,1 mg	IR emitter
WL-306-0077	**MA 200/1.X2.A.NS**	200 g	0,1 mg	metal heater
WL-306-0079	**MA 200/1.X2.IC.A.NS**	200 g	0,1 mg	metal heater
WL-306-0033	**MA 210.X2.A.WH**	210 g	1 mg	halogen
WL-306-0055	**MA 210.X2.IC.A.WH**	210 g	1 mg	halogen
WL-306-0028	**MA 210.X2.A**	210 g	1 mg	IR emitter
WL-306-0053	**MA 210.X2.IC.A**	210 g	1 mg	IR emitter
WL-306-0082	**MA 210.X2.A.NS**	210 g	1 mg	metal heater
WL-306-0083	**MA 210.X2.IC.A.NS**	210 g	1 mg	metal heater

R Series

Product Code	Model	Max. capacity	Readability	Heating module
WL-305-0005	**MA 50.R.WH**	50 g	1 mg	halogen
WL-305-0006	**MA 50/1.R.WH**	50 g	0,1 mg	halogen
WL-305-0001	**MA 50.R**	50 g	1 mg	IR emitter
WL-305-0002	**MA 50/1.R**	50 g	0,1 mg	IR emitter
WL-305-0014	**MA 50.R.NS**	50 g	1 mg	metal heater
WL-305-0039	**MA 50/1.R.NS**	50 g	0,1 mg	metal heater
WL-305-0007	**MA 110.R.WH**	110 g	1 mg	halogen
WL-305-0004	**MA 110.R**	110 g	1 mg	IR emitter
WL-305-0024	**MA 110.R.NS**	110 g	1 mg	metal heater
WL-305-0008	**MA 210.R.WH**	210 g	1 mg	halogen
WL-305-0003	**MA 210.R**	210 g	1 mg	IR emitter
WL-305-0009	**MA 210.R.NS**	210 g	1 mg	metal heater
WL-305-0009	**MA 210.R.NS**	210 g	1 mg	metal heater