APPLICATION NOTE - 33

HITACHI
Inspire the Next

X-MET8000





X-MET8000 series for the rapid and cost-effective analysis of milk powders

INTRODUCTION

Milk powder is produced by removing water from liquid milk through evaporation then spray drying. This increases the milk product's shelf life by several months, and decreases storage and distribution costs. More than 8 million tonnes of powdered milk are produced worldwide annually for a variety of food products, such as infant formulas, confectionaries, sports and nutrition foods. To ensure the product meets specification and quality, the composition of the powders is tightly monitored. This is usually done in a laboratory with inductively coupled plasma spectrometry-atomic emission spectrometry (ICP-AES), involving lengthy chemical preparation stages that demand a high degree of skill. Alternatively, X-ray fluorescence (XRF) spectrometry can be used, requiring simpler and quicker sample preparation steps, while delivering results in few minutes.

Recent advances in XRF technology now allow plants to use small, field-portable analysers to check mineral nutrient contents in milk powders at the production line.

Hitachi High-Tech's latest handheld XRF analyser, the X-MET8000, is a cost-effective, rugged and easy-to-use instrument that fits perfectly in a quality control process, delivering excellent performance for the rapid determination of P, Cl, K, Ca, Mn, Fe, Cu and Zn in milk powders.

INSTRUMENTATION

The X-MET8000 can analyse a wide range of elements, and its optimised combination of a high performance X-ray tube and large area silicon drift detector (SDD) delivers the speed and performance needed for the routine quality control of milk powder.

There is no need for a Helium gas purge: the analysis is simply carried out in air path, which considerably reduces analysis costs. The automatic compensation for varying air pressure and temperature provides outstanding stability, even for light elements.

The X-MET's environmental sealing (IP54 rated) and industrial design ensure minimal ingress of dust, even in harsh environments. Robust, it is ideally located in production sites for twenty-four-hour operation.

With its intuitive user interface, there is little user training required.

Results are displayed on the analyser's large touchscreen, and can also be viewed on a computer (connected to the X-MET via a USB cable), or on your smartphone (using our app). Pass/Fail limits can be setup for each element to alert the operator when the tested sample is not within specification.



Example of results screen



SAMPLE PREPARATION AND PRESENTATION

Some sample preparation is necessary to achieve the highest levels of accuracy and repeatability required for production control. The fine milk powder forms into a strong pellet by compression in a die using a hydraulic press (usually 4 to 6 grams of sample pressed at 2-3 tons for 32mm-diameter pellets). Each pellet is simply placed in the benchtop stand for analysis. Note: the portable light stand could also be used for the analysis.

After entering the sample's identification in the X-MET software, all the operator has to do is to press the analyser's trigger to start the measurement. The initial results appear within seconds, and they are updated until the end of the analysis.

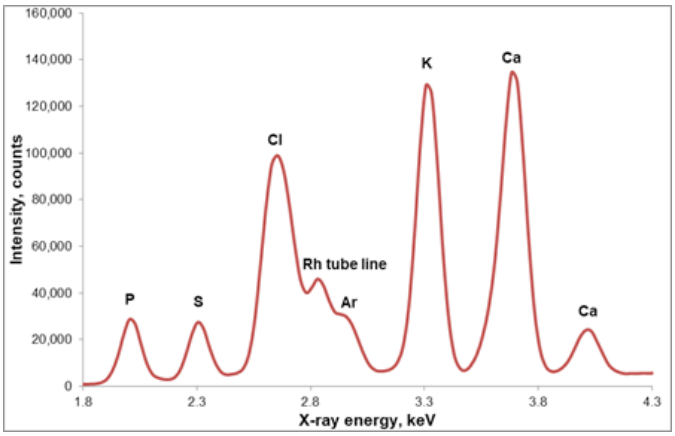


Figure 1: X-ray spectrum of a milk powder sample (low Z elements condition)

CALIBRATION PERFORMANCE AND PRECISION

The X-MET8000 was calibrated using well characterised samples provided by a leading food and beverage company. Table 1 shows the calibration performance, illustrating how the X-MET readily determines a wide range of elements in milk powders, including light elements such as P and Cl.

The measurement time was 300 seconds (5 minutes) per pellet.

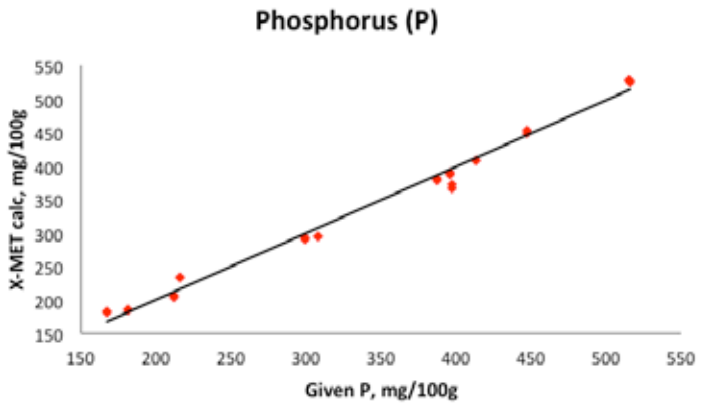
The precision data/instrument stability was obtained by measuring a sample once an hour over a 6-hour period, with no recalibration or restandardisation.

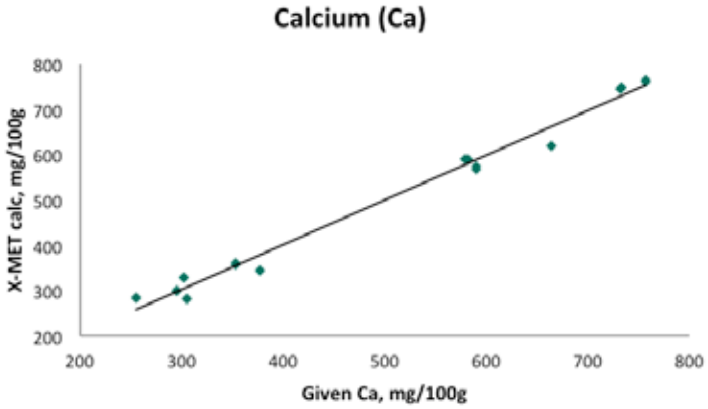
Table 1: Calibration performance for milk powders

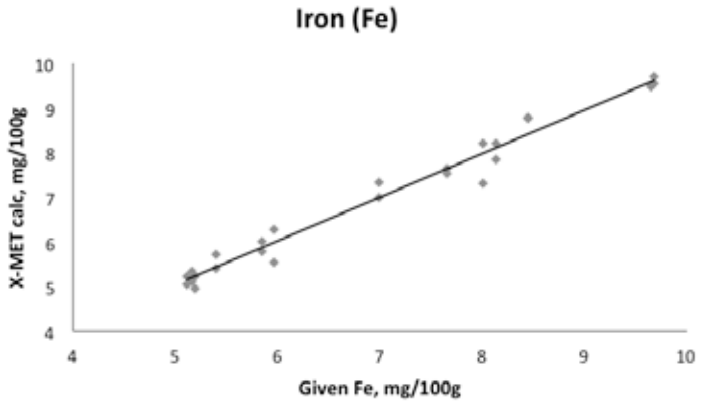
	Calibration Range (mg/100g)	Standard Error of Calibration (mg/100g)	Precision (95% Confidence) (mg/100g)	Limit of Detection* (3σ) (mg/100g)
P	167 - 516	13	3 at 330	1.9
Cl	295 - 583	15	6 at 305	5.9
K	429 - 1125	13	7 at 775	9.1
Ca	255 - 757	23	5 at 600	13.5
Mn	0.03 - 1.30	0.10	0.24 at 1.19	0.18
Fe	5.1 - 9.7	0.2	1.2 at 9.0	0.4
Cu	0.25 - 0.76	0.05	0.04 at 0.60	0.1
Zn	3.4 - 9.5	0.3	0.4 at 6.0	0.3

Note: 1mg/100g = 10mg/kg (10 ppm)
* The limits of detection are calculated for real milk powder samples, not interference-free samples.

Below are the X-MET8000's calibration graphs for some of the key mineral nutrients in milk powders.



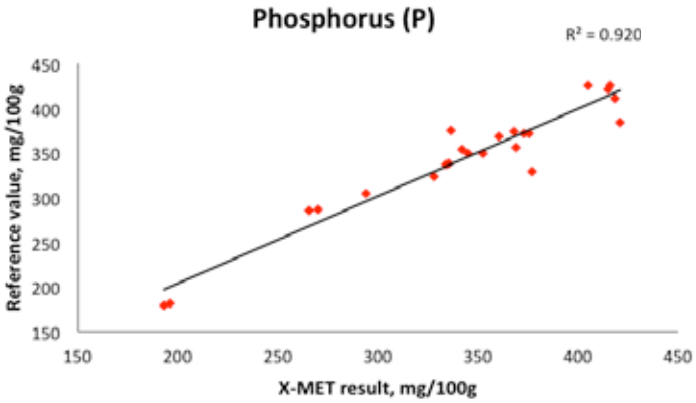


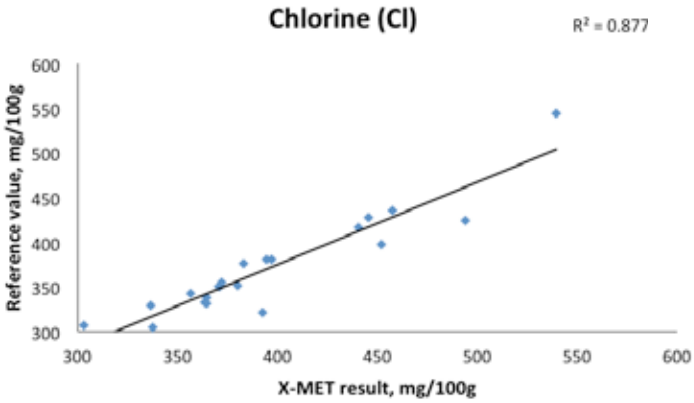


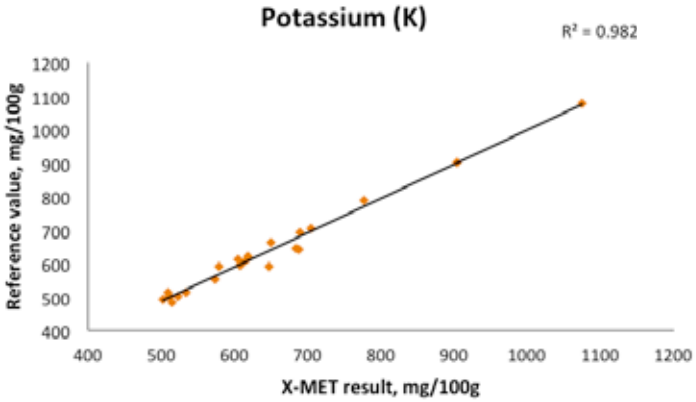
VALIDATION AND ACCURACY

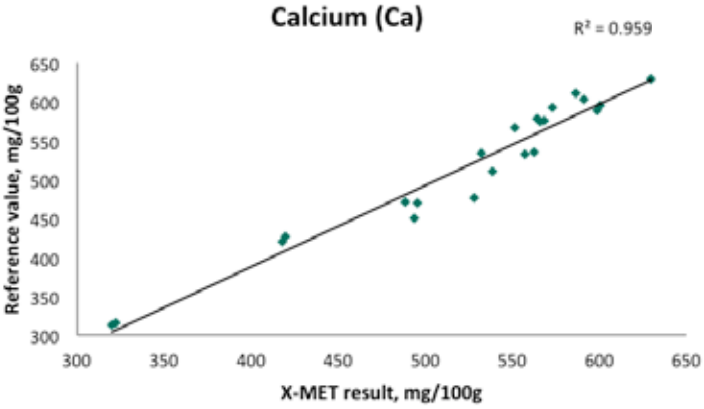
A series of 23 samples were measured in duplicates as unknowns. The averages of duplicates were compared to the customer's internal reference nutrient contents to independently verify the accuracy of the calibration.

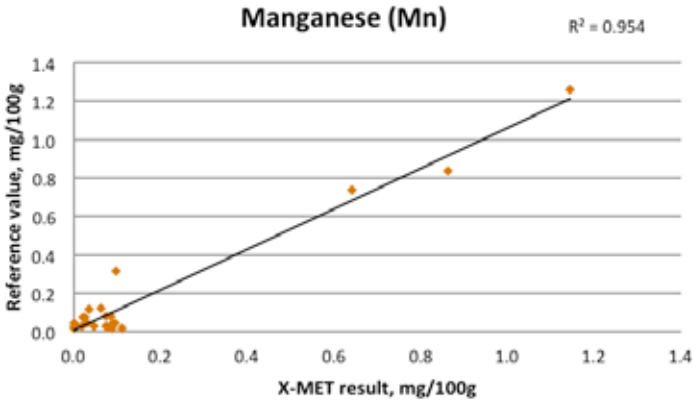
The graphs below show the good agreement between the X-MET's results and the milk powder samples' internal reference values, demonstrating that the analyser can be used for the routine rapid quality control of milk powders.

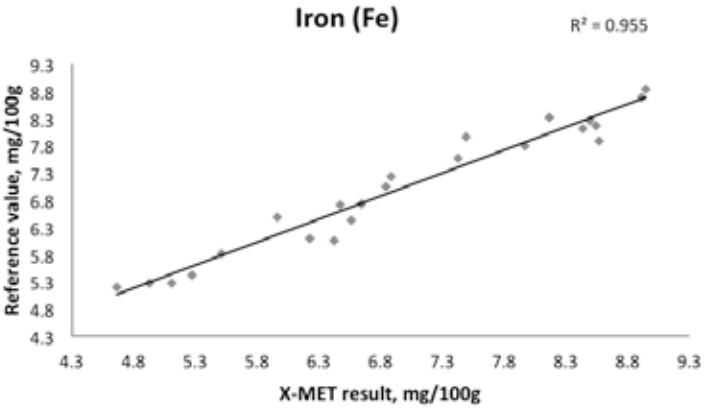

Phosphorus (P)
R² = 0.920
Reference value, mg/100g
X-MET result, mg/100g

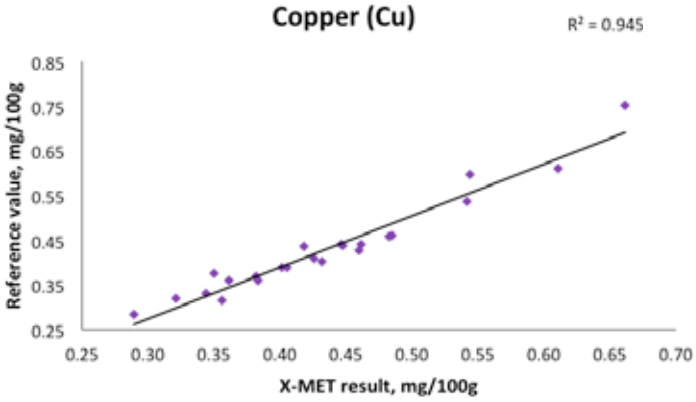

Chlorine (Cl)
R² = 0.877
Reference value, mg/100g
X-MET result, mg/100g

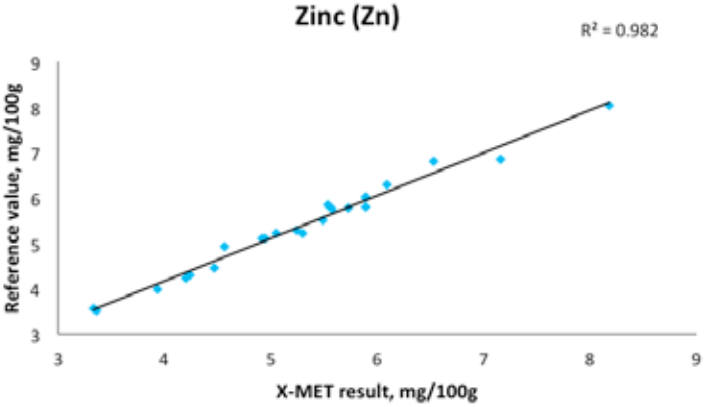

Potassium (K)
R² = 0.982
Reference value, mg/100g
X-MET result, mg/100g


Calcium (Ca)
R² = 0.959
Reference value, mg/100g
X-MET result, mg/100g


Manganese (Mn)
R² = 0.954
Reference value, mg/100g
X-MET result, mg/100g


Iron (Fe)
R² = 0.955
Reference value, mg/100g
X-MET result, mg/100g


Copper (Cu)
R² = 0.945
Reference value, mg/100g
X-MET result, mg/100g


Zinc (Zn)
R² = 0.982
Reference value, mg/100g
X-MET result, mg/100g

SUMMARY

The X-MET8000 provides the performance required for cost-effective routine analysis of key mineral nutrients in milk powders at the production line. Rugged and easy to use, the X-MET can be operated by production personnel twenty-four hours a day, seven days a week.



ORDERING INFORMATION

Minimum required:

- X-MET8000 Optimum or Expert. Includes the compact and rugged carrying case, a wrist strap and lanyard, 2 Li-ion batteries, a battery charger, a USB cable to connect to a PC/laptop, 5 replacements thin film windows, Bluetooth and Wi-Fi connectivity, and the user manuals.
- Small portable stand (included with Expert model) or benchtop stand
- Calibration software (included with Expert model)

Visit **www.hitachi-hightech.com/hha** for more information.

Hitachi High-Tech Analytical Science

This publication is the copyright of Hitachi High-Tech Analytical Science and provides outline information only, which (unless agreed by the company in writing) may not be used, applied or reproduced for any purpose or form part of any order or contract or regarded as the representation relating to the products or services concerned. Hitachi High-Tech Analytical Science's policy is one of continued improvement. The company reserves the right to alter, without notice the specification, design or conditions of supply of any product or service.

Hitachi High-Tech Analytical Science acknowledges all trademarks and registrations.

© Hitachi High-Tech Analytical Science, 2018. All rights reserved.

Part number: 210/0318

Science for a better tomorrow