sisu CHEMA *in pharma applications*

SisuCHEMA is a complete workstation for chemical imaging in the near-infrared region. Its push-broom technology provides a speedy measurement procedure, which facilitates the everyday quality control of pharmaceutical products. With fully exchangeable optics, sisuCHEMA is easily adjusted to the required resolution, which gives the opportunity to study both intra- and inter-tablet properties. The analysis procedure can be fully automated into routine applications using customized scripts. Furthermore, the NIR hyperspectral camera unit along with created calibration models are readily transferable to on-line applications, thanks to the used push-broom technology.

Near Infrared (NIR) imaging is a highly versatile technology for characterization, quality control and quality assurance of pharmaceutical products such as tablets. The sisuCHEMA imaging workstation (picture 1) is a powerful solution in this area, giving a complete NIR spectrum (970-2500 nm) in each image pixel.

The workstation setup is very flexible; the hyperspectral camera can be fitted with a variety of lenses, which, in combination with setting for scan length, give high efficiency to measurement procedures where one or several tablets can be analyzed at the same time.

BLENDING UNIFORMITY, TABLET HOMOGENEITY

SisuCHEMA images a tablet typically in 1 to 3 seconds, or 10 successive tablets in 10 to 30 seconds, when working in a high resolution mode with 30 micron pixel size on the sample. It makes sisuCHEMA the most efficient tool on the market for precise analysis of chemical composition and ingredient-specific particle size in pharmaceutical samples. It can be used for the assessment of blending homogeneity and products' functional quality. There is often a high interest in the distribution of the active pharmaceutical ingredient, api, within the sample. SisuCHEMA makes it possible to detect and identify contaminants and monitor coating quality on samples.

Picture 1. SisuChema imaging workstation
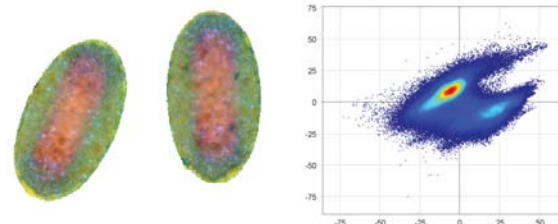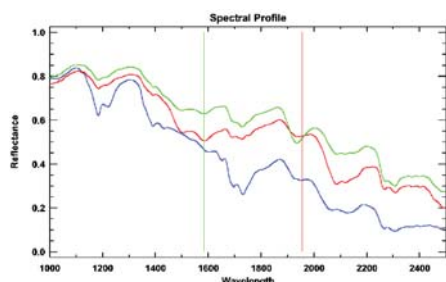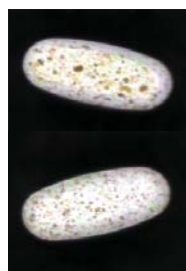
Picture 2. Different ingredients and homogeneity in their distribution in tablets is detected in the NIR image (left), based on different spectra of the ingredients (right).

Picture 3. The active pharmaceutical ingredient is seen in the processed NIR image (left). The score scatter plot (right) shows the distribution of the image pixels in two main clusters.

SISUCHEMA PHARMA APPLICATION NOTE

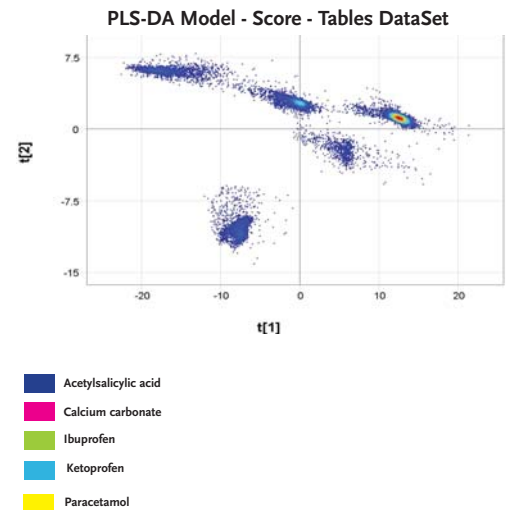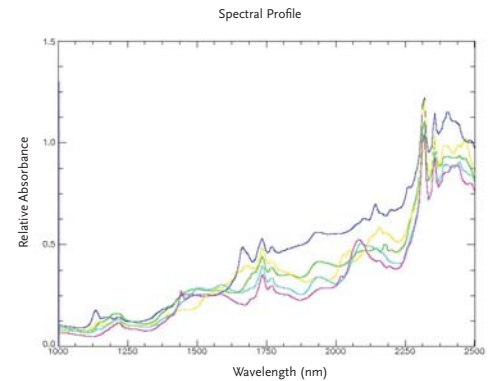## TABLET IDENTIFICATION, FOREIGN AND COUNTERFEIT PRODUCT DETECTION

In the following example (picture 4), sisuCHEMA was used to identify and check the contents of pill sets in plastic bags. The image on the top is a photograph of the pill package. The second image is an NIR image aquired with sisuCHEMA and classified to identify the pills based on their different spectral signatures. Applying principal component analysis (PCA) on the NIR image clearly distinguishes the chemically different pills. The score scatter plot on the right image shows the distribution in PCA score space for all pixels in the NIR image. The five clusters are corresponding to the five different pills.

The bottom image on the left shows an example where the classification revealed the pill set to include two similar pills by mistake.

As demonstrated here, NIR hyperspectral imaging is an efficient tool for identification of pharmaceutical products through the package and checking for the corrrect contents. Similarly, the technique can be applied to detect counterfeit products.

AUTOMATED ROUTINE ANALYSIS

SisuCHEMA is delivered with the Evince data analysis software, which incorporates powerful scripting functionality for setting up automated flows for routine analysis of unknown samples. The hyperspectral camera unit is transferable to an on-line environment for automatical prediction of process samples.

Spectral Profile

PLS-DA Model - Score - Tables DataSet

- Acetylsalicylic acid
- Calcium carbonate
- Ibuprofen
- Ketoprofen
- Paracetamol

Picture 4. Photograph of a pill set in a plastic bag (top left). NIR image acquired with sisuCHEMA and pills identified based on their spectral differences (middle left). Identification of another pill set revealed that it contained 2 similar pills by mistake (bottom left). Typical spectrum for each pill type (top right), and PCA scatter plot which converts spectral discernment between the five pills to 2-dimensional space (middle right).

SisuCHEMA performance specifications

Optical and technical characteristics	SWIR	NIR
Operation mode	High speed push-broom hyperspectral	
Spectral range	970 - 2500nm	900 - 1700nm
Spectral sampling/ pixel	6.3 nm	4 nm
Spectral resolution	10 nm	6 nm
# spatial pixels/ line	320	
Pixel size on sample	Scalable from 30 to 300 microns	
Field of view on sample	Scalable from 10 to 100 mm	
Maximum sample size	100 x 100 x 40 mm (WxLxT)	
Scanning rate	100 hyperspectral line images/ s (max), corresponding to - 3 mm/s with 30 micron pixel - 30 mm/s with 300 micron pixel	
Typical scan time	3 to 10 s for an image with 320 x 320 spatial pixels and full 256 spectral bands	
Illumination	Diffused line illumination	
Data format	BIL file format, Evince end ENVI compatible	
Instrument calibration	Instrument is delivered with spectral calibration. Image data is automatically calibrated to reflectance by measuring an internal standard reference target before each sample scan.	