"On line" quality control in feed manufacturing

Melcion J.P., Riou Y.

in

Morand-Fehr P. (ed.).
Feed manufacturing in Southern Europe: New challenges

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 26

1997
pages 115-117

"On line" quality control in feed manufacturing

J.P. MELCION
Y. RIOU[1]
LABORATOIRE DE TECHNOLOGIE APPLIQUEE
A LA NUTRITION
INRA
[1]TECALIMAN
BP 1627-44316 NANTES CEDEX 03
FRANCE

SUMMARY - The efficiency of "on line" quality measurements is related to the accuracy of sampling, sample division and conditioning of the equipment which has to be robust enough to be installed in an industrial environment. The information provided by the different systems is discussed and it should be compared with and fitted to classical analysis.

Key words: Equipment, feed, on line quality.

RESUME - *"Contrôle de la qualité "on line" dans la fabrication d'aliments pour bétail". L'efficacité des mesures de qualité "on line" est liée à l'exactitude de l'échantillonnage, la division des échantillons et le conditionnement des équipements qui doivent être suffisamment robustes pour être installés dans un environnement industriel. L'information apportée par les différents systèmes est discutée et elle doit être comparée et ajustée par rapport aux analyses classiques.*

Mots-clés : *Equipement, aliment pour bétail, qualité "on line".*

Why to measure "on line"?

On line quality control may refer to different purposes: the first one is to follow the quality of the final product according to time in order to built a data basis, the second one is to control accurately each process itself in order to optimize it and to made the equipment self-running.

A feed production flow sheet can be divided into different steps (or key-processes) i.e. grinding, proportioning, mixing, pelleting and cooling, extrusion-cooking. Each of them is dependent upon numerous parameters. In a first approach, the required optimization of the products as well as the processes needs a precise definition and control of both influencing parameters and system variables, including energy, time, shear, etc. and quality criteria.

What to measure?

The main "results" of a process are the yield of the process on one hand, and the quality of the feed on an other hand. The "yield" means output or specific energy consumption. The measurements of the feed flow, of the electrical intensity, electrical power and mechanical torque are important for the feed manufacturer and for a good management of the feed mill. The "quality" is somewhat larger: it could mean physical properties which are of importance in processing control (i.e. particle size of the meals after grinding, moisture after storage of the raw material or after cooling, viscosity in extrusion-cooking). Moreover, it could be related to commercial aspects (i.e. hardness, durability of the pellets, fine particles into the pelleted feed), and mainly to nutritional aspects (i.e. feed composition, proximate analysis or substantial modifications of one specific component).

How to measure the quality?

Numerous methods are available. One family of methods is based on rapid and non destructive analysis using different types of lights and wavelengths (infra-red, visible and/or laser lights). A second family uses destructive analysis based mainly on behavioral and rheological measurements.

Feed composition

Due to its robust character and its speed of analysis, NIRS has proven potential as an on line analyzer method. Some of which perform in the solid mode on pure raw materials, but they are not adapted to feed mixtures, in a short range of mixtures compositions excepted. It can be interfaced with an on line grinder or non contact optics, automatic sample introduction (to the optics), computer software, connection with the process, flow sheet (dosing process) through a computer and so forth. From sample analysis dates, the computer is able to adjust the feed composition in real time by acting the feed proportioning. The scope of these methods goes far beyond the number of installations, probably because of the price threshold. Starch damage measurement by NIRS of extruded flours within the extruder may be also of potential interest and is presently under experimentation.

Particle size

Laser light diffraction is used for measurement of the particle size of the meal. In-process particle size analysis provides real time measurement (5 seconds) of powdered material as it is being manufactured. The size range of existing apparatus is from 1 μm to 1 mm. Real time measurements allowed diagnosis and correction of non-steady feed rates to a classifier-mill. Automatic feedback control allows to maintain product uniformity only if particle size can be continuously adjusted: gap between cylinders in a roller mill, speed of rotation of the rotor in a hammermill, feed rate of a classifier in feed processing. Image analysis of meals in order to measure particle sizes or shapes begins to be proposed by equipment manufacturers.

Pellet quality

The purpose of an optimization system for the pelleting process is to increase production rate and physical pellet quality whilst also facilitating greater flexibility of mill operators. Variation in product quality can be detected (and corrected) on line through auto sampling and direct testing of the pellet mechanical resistance. Most of the existing measurement principles are based on durability testing. The sample is first cooled, then subjected to air stream which causes them to degrade. Fine particles are then removed and the remaining pellets are weighed. With the appropriate software, the information is used by the press control system. The time of response of the device, according mainly to the cooling time, has to be shortened in order to increase the efficiency of the control.

On-line fine production measurement after cooling could also have potentiality for pelleting control: unfortunately, there no evidence for a relationship between fine production rate and pellet durability.

Apparent viscosity measurements of extruded products are achieved on plastic materials using slip die rheometer. As a potentiality, it can be applied to feed or food flours in order to control the thermomechanical "history" of the product and then its expansion properties.

Concluding remarks

The quality of on-line measurements is related to the accuracy of sampling, sample division and conditioning. The equipment has to be robust enough to be installed into sever industrial environments. The information provided by the different systems need also to be compared and fitted on classical analysis.

If on-line measurements are used as a mean of to controlling processes, one have also to pay attention to the delay between measurement and back reaction according to the feed rate. The validity of the relationships provided by the software between resulting dates and pre-set values of processes variables has also to be checked.