

Consistency measurements developing strongly

Finland has wide network of suppliers and specialized companies for pulp and paper industry. In addition to process machinery as such, many other process supporting technologies are highly advanced in Finland due to the strong local pulp and paper industry. One of these specialities is consistency measurement, which importance for pulp and paper production cannot be understated.

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Within automation and measurement industry, consistency measurement is not a major issue, compared e.g. to temperature, pressure, flow and many other measurements areas, which have millions of applications in every field of industry.

At the same time consistency measurement is not an easy area, but the fact that consistency measurements concentrate only on pulp and paper industry, has been an advantage for the automation industry of the Nordic Countries. The market size is limited and not interesting enough for the biggest automation manufacturers, but large enough for smaller players concentrating on pulp and paper. Nevertheless consistency transmitter manufacturing is a valid business: no doubt there is a suitable size market niche and at the same time local pulp and paper industry has got benefits by improved processes.

High quality pulp has stable quality and consistency, which enables high quality end products to be manufactured for the market. Roughly speaking, the consistency which is measured is the fiber content of the pulp. Consistency is measured in order to measure production or to control the consistency with dilution water to required level for production. This simple consistency control loop includes also flow measurement and PI-controller.

It sounds easy, but is that only

in an ideal mill, which produces always the same grade, using pulp which has been made from exactly the same species of trees and exactly even quality additives.

The real life is different: pulp quality and species vary from hardwood and softwood to recycled fiber, and many different additives and chemicals are used. Also the size of the process varies, environmental issues are more and more important and amount of water used per ton is decreasing. These are some of the many factors affecting also consistency measurement and the reason why many different measurement principles are needed and continuous and intensive cooperation with machine suppliers and research centers is essential.

Consistency Transmitters

In the 40's papermakers "measured" consistency by using wooden stick, and got accurate measurement enough. But when the production increased, basic methods to determine consistency were not satisfactory enough. In the 50's the development of consistency transmitters began in many areas of the world.

First transmitters were pneumatic and used the same principle as wooden stick in the hand of the papermaker, based on the sensing element in the process flow and measuring the shear force caused by fibers. We can say that even the most modern blade type consistency transmitters are descendants of this first method. Rotary transmitters for their part represent more developed shear force transmitters, and are generally viewed as the industrial standard of consistency

transmitters worldwide.

Approximately 20 years ago the first optical transmitters came into the market. They are well suitable for lower consistency measurement range below 2 % and used e.g. in the retention measurement of the paper machine. With higher consistencies optical transmitters perform best with pure pulps.

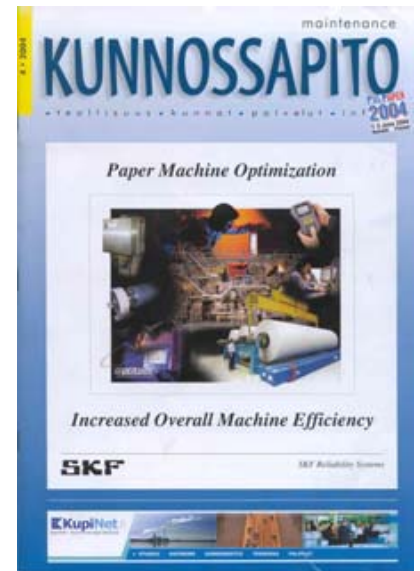
Microwave transmitters were introduced about decade ago. Microwave technology is based on phase difference of microwave and the benefit is the overall accuracy over the measurement range of 0 - 50 %. Microwave transmitters are not sensitive for pulp and process related variations, except the conductivity limitations and disturbances caused by air in the pulp. The high price of microwave transmitters has caused that they are mostly used in the key applications like measuring the production output for invoicing.

Both optical and microwave transmitters have less installed base than shear force transmitters and by taking into account the limited space for this article and the special theme of maintenance, the following will concentrate only on shear force transmitters.

Shear Force Transmitters

Due to low purchasing cost, blade type transmitters are the most popular transmitters in the world, in spite of many technical and operational weaknesses and high lifetime cost of this transmitter type. Users typically think that results got with blade transmitters are satisfactory enough or that only low cost transmitter is justified for the process application. Measurement range of blade transmitters is 2-16 %.

Rotating consistency transmitters have long history as well and offer typically much better meas-



Sensing element of modern rotating consistency transmitter.



Modern microwave consistency transmitter.

urement performance than blade transmitters. Due to their high weight, big size and utilities needed for operation, more difficult maintenance causes higher cost for measurement location.

Rotating consistency transmitters' measurement range 1,5 – 16 % is wider than that of blade type transmitters' and its performance shows up especially in important low consistency measurements. Another important benefit of rotary transmitters is that they work well on low flow rates, which are usual at medium consistencies.

The limitation of both shear force transmitter types has been that maintenance and repair are not possible while process is operating. However, with the new blade transmitter models, robustness and maintainability have improved significantly and nowadays blade transmitters can be serviced in line without shutdown. In addition new robust constructions allow installation to the most severe and demanding applications, like Kamyr digester

blow line.

The newest rotary transmitters can be removed from the process without shutting it down and emptying the line by using an isolation valve, which is a big improvement for maintenance and service. New type transmitters are also easier to serve than older types, which often need specialized technicians.

Shear Force Transmitters in the process

Rotating consistency transmitter has remarkably better performance than blade style type, which major benefit is the low purchasing cost.

From the process's point of view, rotating transmitter is easier to install because it does not require long straight pipe sections for good measurement performance like blade transmitter, which usually needs also separate installed flow straighteners for satisfactory results. This is because rotary transmitter does not need laminar plug flow condi-

tions, so finding a good installation location is much easier, only installation of the process coupling is needed.

Blade transmitters require several different sensing elements – blades, depending on the pulp type and consistency range. The latest developments have increased the measurement range of the blade transmitter and decreased significantly the amount of different blade types needed. In fact the latest type of rotary transmitters can cover all applications and consistencies with a single sensing element.

For the sake of the maintainability, it is important that the transmitter can be serviced and maintained while process is running. In fact this is one of the most important issues when making the purchase decision, especially when measurement application is important for the process. This is undoubtedly the most advanced feature of the newest rotary transmitter.

Sampling

Consistency measurements include essentially sampling, which cannot be bypassed when designing the consistency loop and its management.

Consistency transmitters are calibrated and the process is monitored by samples taken from the process and analyzed in the laboratory. Consistency transmitters are not absolute measurement devices and require proper calibration. Modern mills have understood the importance of sampling for long. Correct installation location of the sampler, representative samples and thorough procedures are clear by itself and nowadays carefully considered in design phase when selecting sampling devices.

Future consistency Transmitters

Consistency transmitters have been developing in the course of their lifetime driven by other technology development, e.g. utilization of microwave technology for consistency measurements.

Recently many techniques and technologies connected to materials, manufacturing and software have improved significantly. New advancements compounded with the expectations of the industry, have sped up the progress of the measurements to be faster than ages. Development is driven also by increased competition between consistency transmitter suppliers.

In the future generally speaking everything related to maintenance will be in focus, mainly from the point of view of the total lifetime costs. The newest transmitters already provide lots of useful information from the process other than just the consistency measurement signal. Development will continue to improve transmitter performance, as well as self diagnostics.

Especially consequential for installation, maintenance and the total lifetime costs of transmitters will be reduced need for utilities and the positive development of the weight of the sensors, making maintenance easier and less labor intensive. One of the most important features will be that transmitters can be removed from the process without disturbing the production.

Due to all previous, shear force transmitters will hold their position as industrial standards, but giving much better performance, being both lighter and more versatile - and having lower lifetime costs.



Blade type transmitters with different sensing elements.



Broad range of sampling devices.