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## Limitless Possibilities – Level Measurement with Radar

This article shows examples of level measurement in different areas of the pulp and paper industry. Specially in areas where existing measuring techniques could not always fulfil the requirements of users, radar is the optimal solution.

### Introduction

Hydrostatic pressure transmitters with lateral mounting are often used for level measurement in vats and storage towers. The advantages are obvious: high measuring precision, simple calibration, stirrers or other installations in the vessel do not influence the measurement. But some disadvantages are the maintenance costs with build up of medium on the measuring diaphragms, the necessary stockkeeping of spare instruments with fitting measuring ranges and the effort of exchanging instruments on filled vessels.

Ultrasonic sensors are often used for level measurement with liquid paper chemicals and additives, while plumb line systems or guided microwave sensors are used in silos containing bulk solids. The advantages here are the non-contact measurement with ultrasonic, the robust mechanical system of the sounding system and the reliable function of the guided microwave. Unfavourable factors here are the temperature limits, the stockkeeping of instruments with different measuring ranges and the high costs of servicing. In addition to that there are problems with dust, pollution and tensile forces. Against this backdrop, alternatives are now often sought after.

### The alternative of radar – the measuring principle

Via the antenna of the radar sensor, short microwave pulses in the GHz range are sent down to the surface of the medium, reflected there and received back again as echoes through the antenna. The running time between sending and receiving is measured and translated into a filling level by the sensor electronics (Fig. 1). The main advantage of radar is the non-contact measuring procedure. Since the microwave pulses, as opposed to ultrasound, do not need a propagation medium, process conditions in the vessel, like pressure, temperature, vapour, dust and noise, have hardly any influence

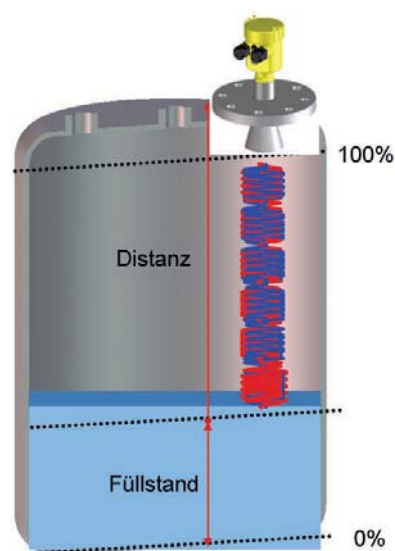


Fig. 1: Functional principle of radar level measurement

on the measurement. This measuring method is as equally well suited for liquids as it is for bulk solids.

### Decor paper: Level measurement in the broke pulper

Technocell Günzach in southern Germany is a leading manufacturer of special high-quality types of edge papers and smooth one-sided foil papers. These decor papers contain high-quality fillers and pigments and are often produced in small batches according to customer specifications. Colours and features are continuously checked-especially intensively during the start-up phase-via online and laboratory measurements.

Until the required quality is reached, the paper is recycled: the paper web is first fed directly into the broke pulper under the reeling section and decomposed there to a pulp density of approx. 4% by adding 30° Celsius screen water and agitating. A level measurement in the pulper controls the emptying and filling of the vessel and thus the material density.

The process conditions in the pulper are: agitated surface due to water jets, falling paper web and a stirring unit. The previous hydrostatic measurement did not work to the complete satisfaction of the user. Unfavourable factors were the unstable measurements, the high cleaning costs due to colour deposits and the difficult access to the sensor, which was located on the side wall of the pulper.

VEGAPULS 61, a radar sensor with plastic horn antenna for liquids measurement, was deployed as an alternative solution. The measurement is carried out in a vertical, approximately 2 m long DN 80 tube, which guides the radar signals and at the same time excludes the effects of the water jets and the falling paper web. Jets of fresh water periodically clean the inner surface of the tube. Due to the non-contact measuring technique and the configuration of the measurement setup, all maintenance work is eliminated; the sensor is directly accessible at any time (Fig. 2).



Fig. 2: Radar level measurement in the pulper below the tambours

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### Thermopaper: Level measurement in the headbox

At one of the leading European suppliers of thermopapers, an effort was made to find a good solution for measurement in the headbox. The level and pressure measurement in the headbox serves to regulate the stock pump and therefore has direct influence on the cross-direction profile of the paper web. The previous level measurement in the overflow outlet was realised with a differential pressure transmitter. This meant that the differential pressure pipes installed for the measurement had to be continuously flushed with sealing water and completely cleaned at regular intervals. Furthermore, air bubbles in the sealing water had an adverse affect on measurement accuracy. The level measurement setup in the overflow was therefore replaced by the VEGAPULS 63 radar sensor with front flush, PTFE-encapsulated antenna system with DN 80 flange. With its millimetre-precise measurement, it guarantees a constant filling level in the overflow – and that with a filling level of only approx. 450 mm and superimposed pressure up to 0.7 bar. Installation is carried out via an existing man-hole lid. The excellent signal focussing provides exact orientation of the radar sensor, avoiding the disturbing influence of the perforated roll.

### Pulp production: Level measurement in the thick lye tank

With a production capacity of 570,000 tons/year of bleached long-fiber cellulose, Zellstoff Stendal in northern Germany is the most modern and largest manufacturer of market pulp in Central Europe. The high-quality fibrous material is further processed into printing and toilet papers, among other things, and also used as reinforcement fibre in waste paper recycling. The black liquor arising from cellulose digestion is thickened to a dry content of 75% in the evaporation system. A viscous liquor is thereby created, which is stored at approx. 80° Celsius in the approx. 17 m high, insulated thick liquor tank. The required level measurement in this tank is evaluated via the control system and ensures a continuous process.

The previous level measurement was realised with a hydrostatic pressure transmitter. The pressure transmitter was mounted laterally in the lower area of the thick liquor tank. Through sedimentation of the liquor, build up

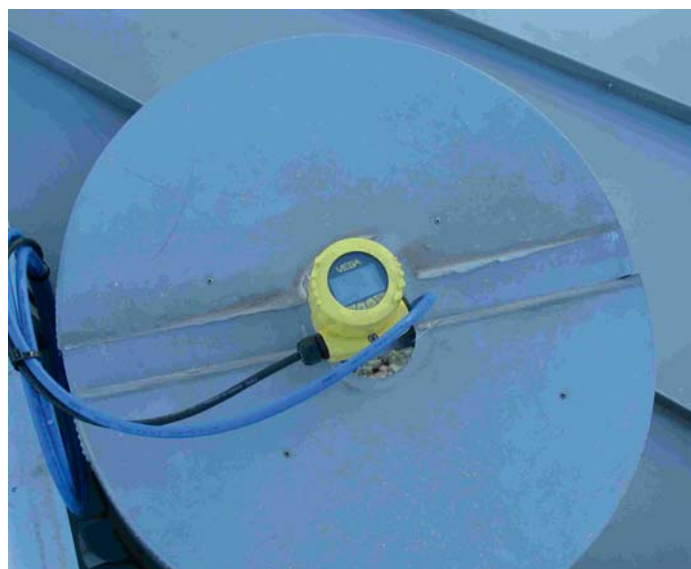


Fig. 3: Radar level measurement in the thick liquor tank. The sensor is included in the tank insulation

formed on the container walls and on the sensor diaphragm again and again. This resulted in unreliable measurements and high servicing costs for demounting and cleaning of the transducer.

The radar sensor VEGAPULS 66 is optimally suited for level measurement under the conditions described above. A steady, light flushing of the antenna with compressed air prevents build up on the antenna system from vapour precipitation and ensures maintenance-free operation (Fig. 3).

### Book paper: Level measurement in the starch silo

Mochenwangen Paper in southern Germany is a tradition-rich manufacturer of high-quality papers for book production as well as for web and sheet fed offset printing. It delivers, among other products, the paper that was specially developed for the novel series "Harry Potter". Chlorine-free bleach, a slight wood content, special surface treatment and a special "feel" were, among other things, the requirements of the author and the publishing house. The raw materials are mechanical wood pulp, waste paper, long and short fibre cellulose, filling pigments and auxiliary materials. Important components included to achieve this quality are chlorine-free peroxide bleach as well as a specially prepared starch used for gluing.

The required raw starch is stored in a silo with a height of approx. 12 m and a diameter of approx. 3 m. The level measurement is evaluated via the control system and ensures a sufficient supply of starch for production. The previous measurement setup was realised with a mechanical plumb line system. It worked only intermittently and had to be regularly serviced.

In the course of modernization, the measurement setup was changed to one using a VEGAPULS 67 bulk solid radar sensor. This instrument is optimised for process conditions like dust and unfavourable reflective properties and operates completely maintenance-free (Fig. 4).



Fig. 4: Radar level measurement in the starch silo

## Newsprint paper: Level measurement in the ash silo

UPM Schongau in southern Germany, an important manufacturer of newspaper printing papers and natural papers with high filler content, produces up to 750,000 tons of paper per year on three modern production lines. The raw materials are waste paper and TMP as well as the fillers kaolin and PCC.

The large quantities of fibre residue substances created in production are dried, stored in a silo and later burned. The still hot ash is conveyed pneumatically into storage silos up to 25 m high. Filling, emptying as well as the associated logistics are controlled via a level measurement which provides essential information to the control system. Measuring conditions are dust, noise and material cones during filling as well as cornices during emptying. Plumb lines, ultrasound, guided microwave as well as strain gauges were used as measuring systems up till now, all of which did not work to the full satisfaction of the user. The disadvantages were: high maintenance costs, frequent cable break, temperature sensitivity as well as inaccuracy.

The bulk solid radar sensor VEGAPULS 68 is now implemented as a solution. The high sensitivity of the sensor is precisely adapted to the ash and its extremely low  $\epsilon_r$  value and unfavourable reflective properties. With its measuring range up to 70 m, the sensor is universally deployed for all silo sizes. Automatic compressed air rinsing for the antenna system keeps the measurement setup operational without further servicing (Fig. 5).



Fig. 5: Radar level measurement (picture middle) and capacitive max. detection (on the right) in the ash silo. Above and below in the picture the pneumatic filling pipes are recognizable

## Summary and outlook for the future

The rapid development of level radar has led away from large, costly instruments that require much time and effort to parameterise, to small, efficient, cost-effective and at the same time service friendly sensors. Suitable instrument versions are now available for widely different measurement tasks (Fig. 6). This development opens up still more diverse application possibilities for the radar measuring principle in the pulp and paper industry.

Fig. 6: The applied radar sensors VEGAPULS 61, 63, 66, 67, 68 (from left to right) differ in their antenna configuration and sensitivity

