New Method of a Silo Stress/Pressure Observation Using the 3Dimensional Indicator

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ABSTRACT: *The poster deals with new method of a silo stress/pressure observation using the 3D projected indicator detecting of real pressures/stresses in vessels, bunkers and silos. The unique design of the 3D indicator in cooperation with appropriate used software, and with a silo model is able to assure a clear image to pressure/stress identifications in particulate solid. Moreover, the third dimension is unique and enriches the area of the pressure knowledge.*

The measurement process incl. the procedure of processing values using the created interactive software environment has been explained in the poster intimately and investigated in a real silo loaded by a poured bulk solid.

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1 INTRODUCTION

In recent years there has been extensive work on modeling of bulk solid behavior as a collection of large numbers of particles. The granules and particles in most bulk solids and powders are in a state far removed from the ideal for solids just described [3].

The apparatus used for measuring the bulk solid properties of a powder is, for the most part, rather simple [3,4]. The difficulty is to interpret the results obtained. Enough has been done to disclose some of the problems. For example, angle of repose and bulk density both depend on the size of the heap and the manner of the formation and the tensile strength depends on the structure of the packing, which is variable. Shear strength measurements can be complicated by the formation of arches bridging the powder [4]. In practice, wall adhesion of a non-representative portion of the whole powder may be needed. Attention to interparticle cohesion which is accordingly rather small has been taken in last decade; it has been nevertheless sufficient to cause agglomeration of fine particles and adhesion to the surfaces of containers. The cohesive forces found in practice are for the most part non-specific, increase as particle size is reduced and vary markedly with relative humidity. An additional attractive force may arise from surface tension if layers of a bulk liquid are present. Electrostatic charges, even if dissipated quickly on contact, may help to bring particles within the range of the van der Waals forces. The van der Waals inter-particle forces for micro and nano-structured particles are fully theoretically described by Hamaker constant. Within the equation that describes van der Walls forces, the Hamaker constant is a "keystone", that describes how strongly two materials interact [1].

Enough has not yet been done to measure powder properties unequivocally, and this is why care has been taken to describe experiments in some detail throughout the whole of this work and as far as is possible to present the results of what was actually measured. It is hoped that the latter will stand whatever interpretations may be found in the future. Furthermore, no attempt has been made to cover all available experimental evidence. Much of the literature reports on one property and, only occasionally, on two or more properties of the powders studied; it is therefore difficult to synthesize. Instead, emphasis has been given to the more comprehensive experiments made on powders.

The first swallow that may be a possible to help to the problem solution is an identification of a pressure inside storage mass using pressure (stress) detectors furnished the 3D Indicator. The 3D Indicator is able to assure a clear image to pressure/stress identifications in particulate solid. Moreover, the third dimension is unique and enriches the area of the pressure knowledge.

2 NEW METHOD OF A SILO STRESS/PRESSURE OBSERVATION USING THE 3DIMENSIONAL INDICATOR

Stresses acting inside a silo loaded a bulk solid are very complicated to description and moreover, the bulk solid behavior usually depends upon storage and environmental conditions, such as storage time, temperature, moisture, etc. Factors, such as mechanical-physical properties (size distribution, shape, porosity and so on) [3,4] and actual conditions among particulates considered for fine and nano-structured particles (electrostatic and chemical changes, Van der Walls forces) may also change the bulk solid behaviour comparatively.

Above mentioned reasons for bulk solid pressure observation using a bulk solid modelling are thus given.

The new method of a stress bulk solid observation depends on a detector deformation (Fig. 2) of the 3D indicator by the silo model loading (Fig. 1). The deformation of a circle steel face of the 3D indicator (Fig. 2) a bulk solid mass is developed. A stress deformation of detectors glued on a circle inner face of the 3D indicator is transmitted via AD transmitter to a computer and reported there using friendly software.

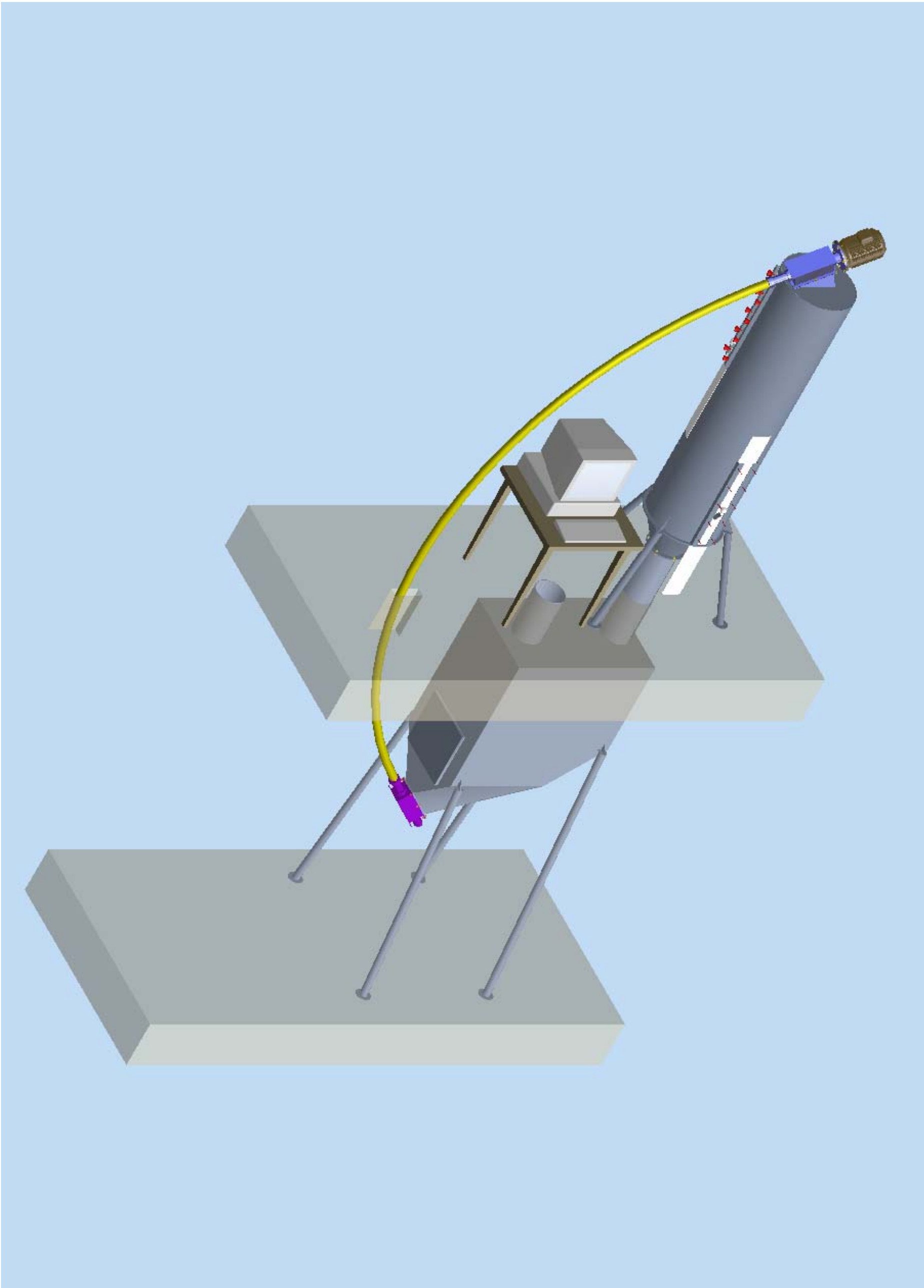

Figure 1 – Silo model to a bulk solid property observation

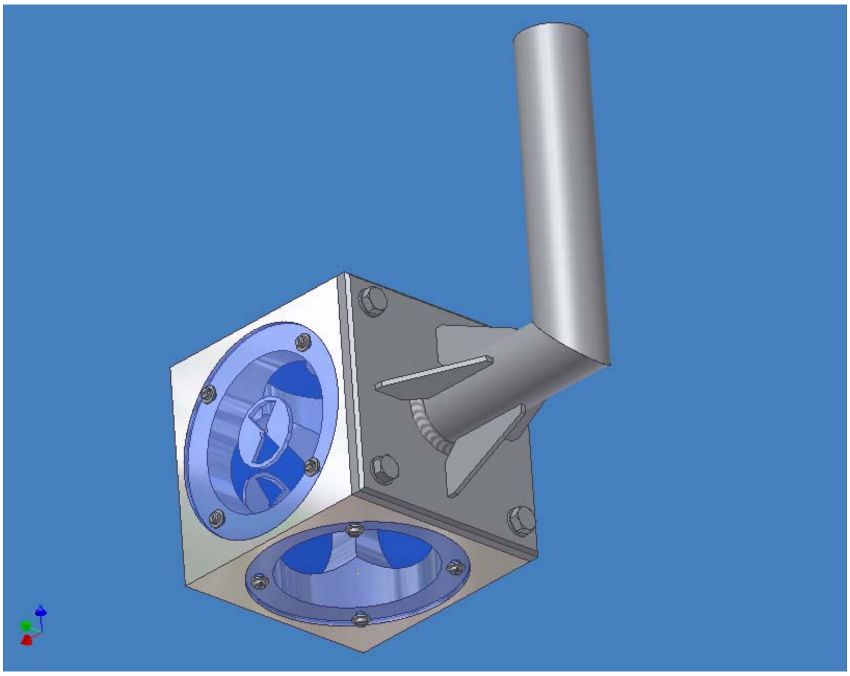

Figure 2 – Real model of the 3D indicator for a silo stress observation

3 CONCLUSIONS

Contribution to the area of the bulk solid triaxes stress observation is to find the method that can indicate a bulk solid stress direct to an inner bulk solid body. Unfortunately, current indicators work in 2D generally and moreover, usually are situated to inner circumference of a body silo.

The poster presented by the ICEER 2004 conference will be completed by real stress bulk solid measurement results incl. the real 3Dimensional indicator, which is proceeded to be the patent, and developed to be a method tool to Standard Bulk Solid Stress Measurement.

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