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DETERMINATION OF THE VOLUME OF THE TANK OF RAILWAY WAGON WITH RIBBING

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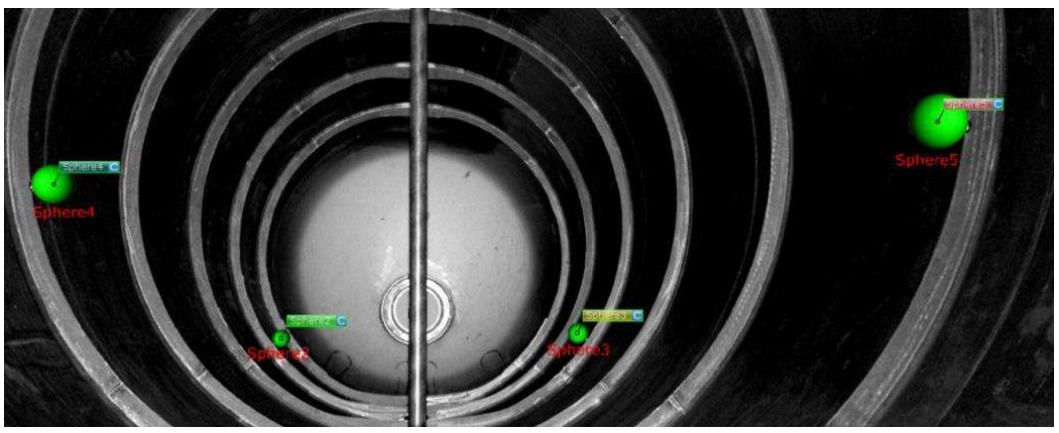
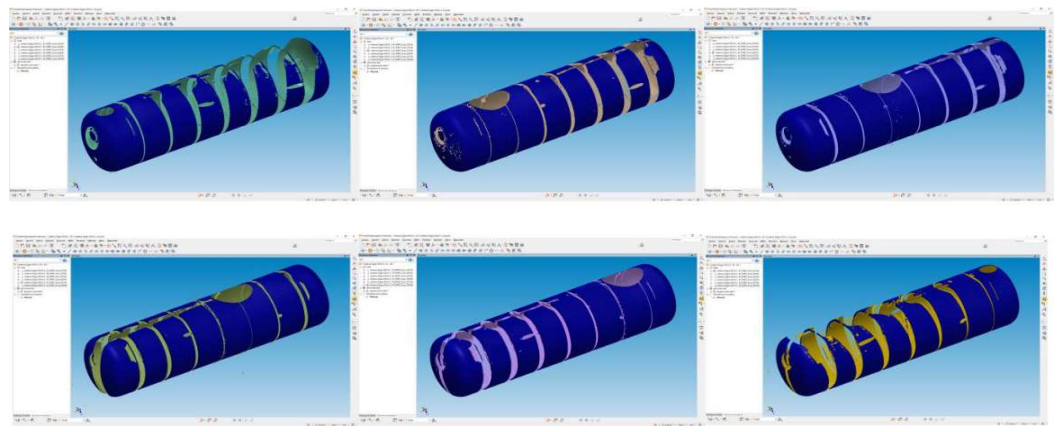
Introduction

The tank wagon chosen for the volume measurement has nominal volume 85 m^3 ± 1%, length 11970 mm and a diameter 3100 mm. Until now, the volumetric method of filling water and simultaneously measuring its volume with flow meters has been used [3], which is a time-consuming method requiring a special workplace with powerful pumps. During the measurement, there is a large consumption of water, which is contaminated with impurities from production after the measurement and it is necessary to ensure waste management for it. Electricity is used to drive the pumps during filling and draining and also to dry the tank after measurement.

Thus, 3D scanning procedure has been used as alternative to measure the volume and reduce the environmental burden. In the literature, analyzes of measurements of cylindrical vessels with a simple cylindrical surface [6], [7] are mostly described and there is a lack of studies with measurements of large vessels in which strengthening elements are used for stiffness reasons.

So, the main aim of this research was to compare the measurement of the volume of such a tank by volumetric and scanning method and to compare the accuracy and time efficiency of both procedures.



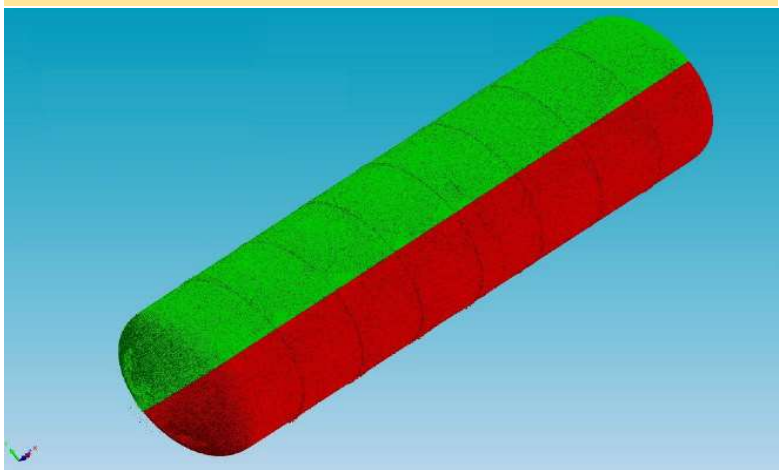


In this case, measurement at six positions of the scanner was necessary in order to measure all the internal contour points. The scans were aligned using the set of reference balls. Then, a cloud of the contour points was processed and model of the wagon was created (see Figs.). Integration within created model (sum of green and red parts) provide the volume value with accuracy given by the resolution that was studied in detail finding that the trend of the calculated volume depends on the step size, corresponding to the linear function

*f(volume) = -247.2*step + 85430*

Results

By comparing the two measurements in terms of accuracy, method of design and time, both methods of measurement are suitable for volume measurement and their accuracy meets the technical requirements for tank volume tolerance. From the point of view of time, the measurement with the FaroFocusS spatial scanner is more advantageous, because the measurement of the tank (observing the prescribed deviation of the volume tolerance) lasts altogether with the evaluation 36 minutes, i.e. it is 3x faster than the measurement with flow meters (113.5 min.). Another benefit of measuring with a scanner is the acquisition of data enabling the creation of an object model for other measurements.



Conclusion

Effectiveness of measuring the internal volume of the railway tank with ribbing using a 3D scanner and a pair of volume flow meters as a reference was compared. The measurement with the 3D scanner proved as time-shortening (3x faster), enabling other measurements using a model, significant water and electricity savings.

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