

REPORT:

● ADDRESSING PET STORAGE PROBLEMS IN SILOS

It is predicted that the global consumption of PET packaging will grow to almost 19.1 million tonnes by 2017, with an annual growth rate of 5.2 percent between 2012 and 2017^[1]. In the UK there is a considerable and growing tonnage of both raw and recycled PET plastic being processed.

The increase in the use of PET feedstock has led to greater storage of the material both in greenfield manufacturing facilities dedicated to PET and in the conversion of plant from other plastic types. Unfortunately, the material properties of PET are quite different to many commonly used plastics and three main problems can arise when storing/discharging PET: silo honking, silo quaking and silo overloading.

SILO HONKING
Also known as silo noise or music, silo honking occurs when the PET material is moving within the silo and generates a low frequency (>20Hz) sound. This noise is intermittent (with intervals between seconds or hours), unpredictable and typically sounds like a truck horn^[2]. The volume of this noise is sufficiently loud to be of concern where silos are installed close to environmentally sensitive or residential areas and has led to noise abatement orders being issued.

SILO QUAKING
Also known as silo thumping, silo quaking is again related to the movement of PET granules within the silo but, in this case, the movement and rapid deceleration of a greater mass of material can cause buckling of the silo wall or even catastrophic failure of the silo's structure.^[3]

SILO OVERLOADING
If silos have been designed to suit most common plastics, stress calculations are likely to have been made using a bulk poured density of around 600 Kg/m³. Filling them with PET, which has a bulk poured density of 850 Kg/m³, will result in serious

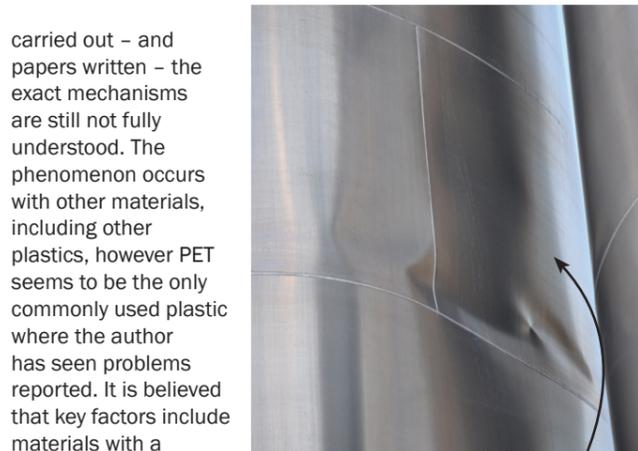
overloading of the silo. This can be over 40 percent more than the original design stress and can lead to the complete collapse of the discharge cone or skirt region of the silo.



PET storage vessels showing wall buckling caused by silo quaking.

The image on the left shows two, one-year-old silos used for storing PET granules. The vessels had not been designed with any anti-honking / quaking protection and serious buckling damage can clearly be seen on the third and seventh panels of the left-hand silo and the seventh panel of the right-hand silo. These silos were replaced by PET storage silos and have operated successfully for over four years without re-occurrence of noise or structural damage.

Silo honking and quaking has been recognised for many decades and although there has been considerable research



Close up of silo wall showing the extent of buckling

carried out – and papers written – the exact mechanisms are still not fully understood. The phenomenon occurs with other materials, including other plastics, however PET seems to be the only commonly used plastic where the author has seen problems reported. It is believed that key factors include materials with a relatively high poured bulk density and co-efficient of friction. Table 1. shows the range of density, coefficients of friction and poured bulk densities for a number of common plastics. It can be seen that PET has relatively high friction and poured bulk density compared to the other polymers.

Plastic Type	Density g/cm3	Coeff of Friction Value	Form	Poured bulk Density Kg/m3
PET (PETP)	1.37 – 1.45	0.18 – 0.22	-	850
PE (LDPE / HDPE)	0.91 – 0.96	0.08 – 0.22	Pellets	561
PVC	1.30 – 1.58	0.20 – 0.30	Pellets	625
PP	0.57 – 0.92	0.10 – 0.30	Pellets	513
PA (Nylon)	1.11 – 1.29	0.16 – 0.35	Pellets	561
PTFE	2.10 – 3.90	0.06 – 0.35	-	-
PEEK	1.31 – 1.51	0.38 – 0.43	-	-

Table 1. - Density and Co-efficient of friction values for common plastics [4], [5] & [6]

SOLVING THE PET PROBLEM

Although the exact cause and modelling of the problem is incomplete, there is sufficient practical knowledge of the issue for silo manufacturers to be able to offer solutions that avoid honking, quaking and overloading problems. These involve changing the way material flows inside the silo, particularly increasing the friction between the material and the silo wall, combined with increasing the silo strength to be able to resist any high transient stresses and the higher bulk density of PET. In practice, it is very difficult to predict when silo honking or quaking will occur, but, for example, Barton Fabrications' anti-honking ring silo design has been widely and successfully adopted, addressing every silo honking / quaking issue that the company has encountered. Barton's anti-honking ring design can be specified and fitted in both new silos or retrofitted to existing vessels that need to be used for PET granule storage.

Rather than risk serious safety issues, or the high cost of a new silo installation, suitable silos can generally be upgraded to include anti-honking rings and stronger base sections offering a more cost effective solution for PET storage to the plant manager.



Complete silo in vessel fabrication tower - vertical construction minimises weld stresses



Mark Barton - MD Barton Fabrications inspects silo access door

FURTHER INFORMATION
WWW.BARTONFABS.CO.UK

References

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