MECHANICAL PROPERTIES OF FOAMED PROPELLANTS

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Abstract

Mechanical and burning characteristics of foamed propellants used as combustible cartridges have to be well composed in order to provide their proper function in a weapon. This work focus on the mechanical properties of combustible cartridges and shows, how they depend on different manufacturing parameters respectively. A basic problem, which emerges when mechanical stability at the shot is unsufficient, is a phenomenon called gas-slipping. Gas-slipping occurs when a cartrigde cannot withstand the boost caused by the igniting-process. In this case gas gets ("slips") from the cartridge chamber into the gun barrel before the projectile arrives. This effect causes undesirable impacts on a weapon, like low projectil velocities and low reproducibility of shot-series. Hence, the goal of the investigations shown in this paper, is to improve the mechanical properties of combustible cartridges. Chemical and physical parameters were systematically changed in the manufacturing process before defined cartridge-segments were measured in a material testing machine.

Experimental

The measurement of the mechanical properties were carried out by compressing defined foamed propellant segments in a material testing machine. Basic mechanical parameters as $Stress_{max}$, E modulus and $Strain_{max}$ were determined via software.

The foamed propellant, the cartridges are made of, consists of three main components:

a) explosive filler
b) binder
c) energetic binder

Type, mode and proportion of all components have naturally a decisive influence on mechanical properties.

The influence of the particle size of the explosive filler is taken as an example in Figure 1. Precisely, Figure 1 shows how mechanical parameters as $Stress_{max}$, E modulus and $Strain_{max}$ are related to the ratio of coarse to tiny particles. Apparently, a negative impact on mechanical properties is caused by the integration of only coarse particles into the foam structure.

An example of a manufacturing parameter which has a very strong effect on mechanical properties is shown in Figure 2. $Stress_{max}$ and E modulus increase immensely with rising foam density.

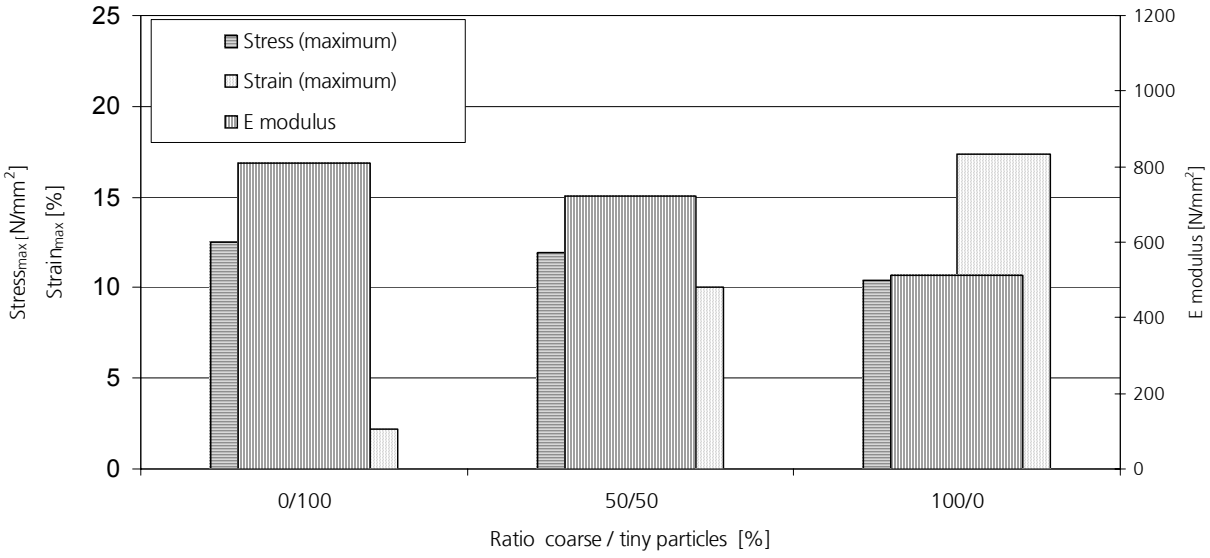

Figure 1: Influence of the particle size of the main component on mechanical properties of foamed propellants

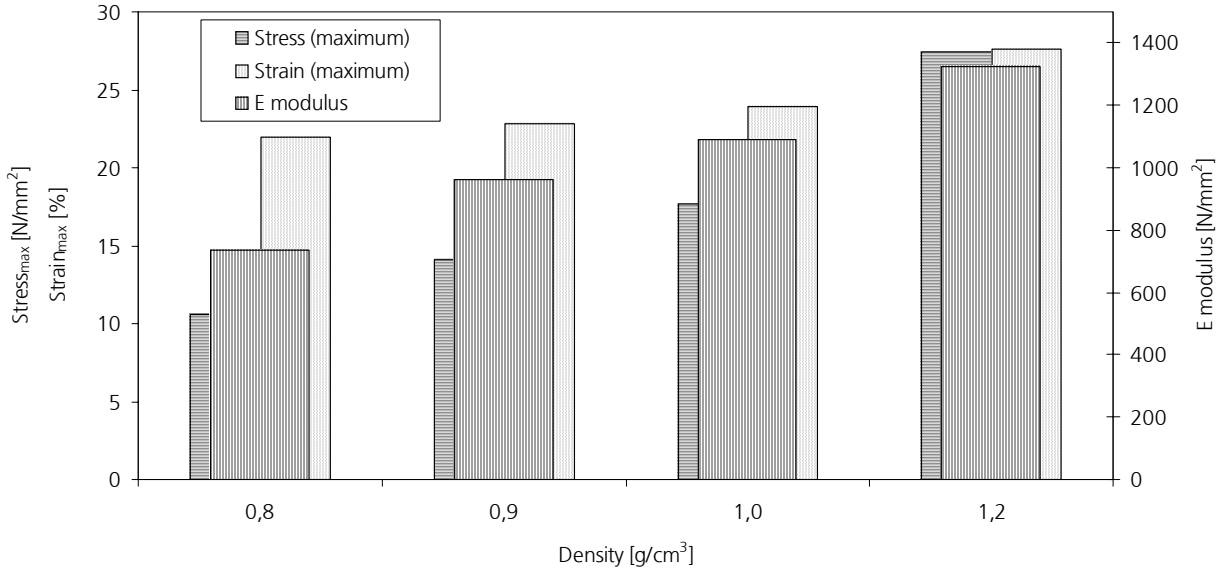

Figure 2: Influence of density on mechanical properties of foamed propellants

Summary

Mechanical properties of foamed propellants used as combustible cartridges can be improved by adjusting certain manufacturing parameters. Exemplarily it is shown that the particle size of the main component has a significant impact on mechanical behaviour. Furthermore the strong influence of density is taken as an example. When changing either chemical or physical manufacturing parameters, it has to be taken into account that good burning characteristics not get lost.