



TEST OF CHARACTER

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GERMANY, PRESENTS SOME OF THE MAIN
CHARACTERISATION METHODS THAT HAVE BEEN
DEVELOPED FOR SOLID ALTERNATIVE FUELS.

Introduction

Nowadays, the use of alternative fuels has become common in the cement industry, as demonstrated by recent efforts to improve their availability and increase the substitution rate with fossil fuels. However, there are still many problems in the handling and processing of alternative fuels, caused by the use of the wrong equipment or by a lack of knowledge of the specific characteristics of alternative fuels. General knowledge of the basic characteristics of bulk materials is essential for proper handling, dosing and feeding, and it is essential that it is utilised for solid alternative fuels.

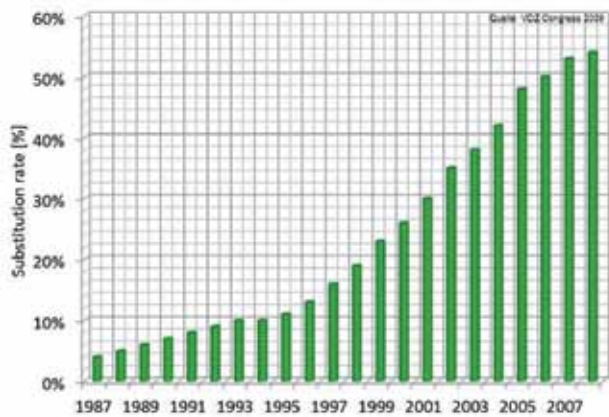


Figure 1. Substitution of fossil fuels in the German cement industry.



Figure 2. High capacity bucket elevator for RDF and other alternative fuels



Figure 3. Di Matteo's MultiFUEL system: a leading modular system for easy use of alternative fuels.

Cement plants in Germany started to replace fossil fuels with alternative fuels in the early 1980s. Today, the use of alternative fuels in the country's cement industry has increased to more than 54% (Figure 1). The use of alternative fuels is key to competitiveness and marks a credible effort towards environmental sustainability.

Alternative fuels encompass all different kinds of materials that can be used adequately in the thermal process. The main types used in cement plants are animal meal, municipal waste, tyres, rice husks, refuse derived fuels (RDF), sewage sludge, rubber chips and wood chips.

Characterisation of solid alternative fuels

For successful use, it is essential to know both the chemical characteristics and physical properties of the solid alternative fuels being handled.

Existing standards for characterisation

In Germany, there already exist some common standards and regulations for the characterisation of solid alternative fuels:

- DIN EN 15357: terminology, definitions and descriptions.
- DIN EN 15358: quality management systems – special requirements for use during the production of solid alternative fuels.
- DIN EN 15359: specifications and classification.
- RAL-GZ 724 (technical regulation): quality assurance.

The existing standards focus on the basic specifications and common definition to enable the general use of alternative fuels. They do not deal with details regarding physical properties and definitions.

There are some standards for calorific and mechanical characterisation, as well as a wide range of standards regarding chemical characteristics, covering almost all requirements.

Calorific standards

- DIN EN 15400: determination of the calorific value.
- DIN EN 15403: determination of the ash content.
- DIN CEN/TS 15404: procedure for the determination of the melting behaviour of the ash at defined temperatures.
- CEN/TR 15716 (DIN-article): determination of the combustion behaviour.

Standards for mechanical characterisation

- DIN CEN/TS 15401: procedure for the determination of the bulk density.
- DIN CEN TS 15406: procedure for the determination of the affection of arching.
- DIN EN 15415/1: determination of the particle size distribution – part 1: procedure of sieving for small particles.

Chemical characteristics

- DIN EN 15402: determination of the content of volatile components.
- DIN EN 15407: procedure for the determination of the content of carbon (C), hydrogen (H) and nitrogen (N).
- DIN EN 15408: procedure for the determination of the content of sulfur (S), chlorine (Cl), fluorine (F) and bromine (Br).

- DIN EN 15410: procedure for the determination of the content of the main elements (Al, Ca, Fe, K, Mg, Na, P, Si, Ti).
- DIN EN 15410: procedure for the determination of the content of the elements (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, Tl, V, Zn).
- DIN EN /TS 15412: procedure for the determination of the content of metallic aluminium.
- DIN EN 15440: procedure for the determination of the content of biomass.
- DIN CEN/TS 15747-14C: procedure for the determination of the content of biomass.
- DIN CEN/TS 15414/1: determination of the water content by drying – part 1: determination of the content of the total water by reference method.
- DIN CEN/TS 15414/2: determination of the water content by drying – part 2: determination of the content of the total water by a simplified method.
- DIN CEN/TS 15414/3: determination of the water content by drying – part 3: determination of the water content in usual samples.

Required standards for physical characterisation

In practice, there are essential standards missing for the determination of physical mechanical characteristics that are important for correct dimensioning of installation for solid alternative fuels.

In general, the following mechanical properties are required:

- Standard for the determination of the bulk density, especially considering the different handling processes and stress fields, i.e. in storage.
- Standard for the determination of flow properties, especially wall friction and internal friction.
- Standard for the determination of the compressibility, as an important characteristic for the porosity.
- Determination of time-dependent characteristics, i.e. time consolidation and compaction.
- Determination of the stress ratio of the horizontal and vertical loads.

There are no standards for the properties mentioned above and the existing standards are not applicable for the determination of the bulk density.

State-of-the-art reference installations

In general, all kinds of installations for the use of solid alternative fuels can be divided into six stages: reception, preparation, storage, transport, dosing and process feeding. There are also other alternatives to successfully handle solid alternative fuels. The right concept depends not only on finances, but also on other aspects (i.e. geographical or local aspects). Furthermore, the alternative fuels' characteristics have to be considered.

Considering the different characteristics of different solid alternative fuels, the handling system should be chosen properly. The proven MultiFUEL installation is particularly suited to high calorific RDF with higher compressibilities. The design of the equipment avoids higher compressions of the material, thus the material keeps its beneficial

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Figure 4. Solid alternative fuels.

characteristics until feeding into the process. By avoiding bigger storage volumes, a continuous and constant retention time of the material within the installation can be realised.

Di Matteo has developed a special bucket elevator design for vertical elevation of solid alternative fuels. State-of-the-art bucket elevators are used for normal bulk materials, based on theoretical studies from the early 1960s. The characteristics of alternative fuels differ in general from normal bulk materials such as cement or raw meals. Therefore, the right bucket elevator must consider the wide variation of density of the particles. The wide range of solid alternative fuels differ, i.e. regarding the flying characteristics. Di Matteo has developed a special bucket elevator design by optimising the form of the buckets. Furthermore, the bottom and head section were modified to be flexible for the material's wide range of particles. 🌐

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