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TECHNICAL PAPER

Typical composition of EPDM granules for sports and leisure flooring

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Brief overview

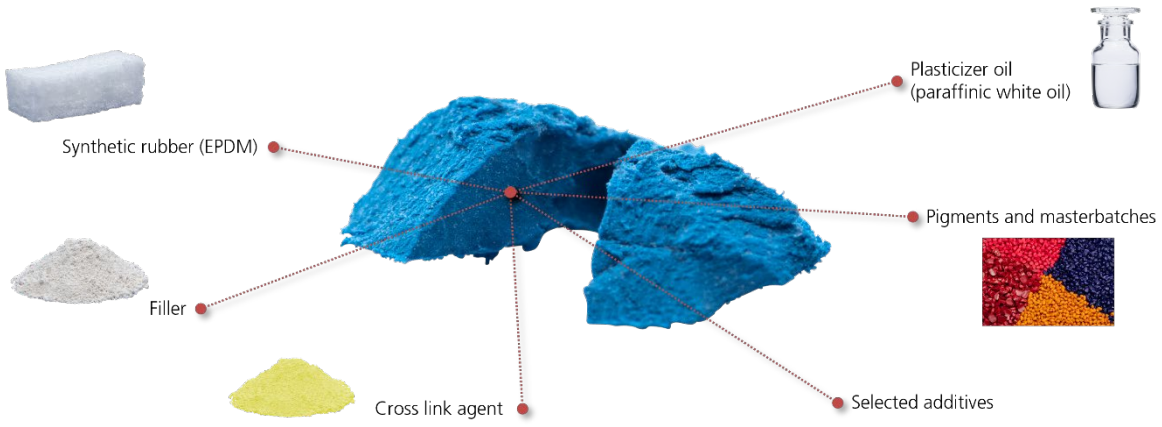
Rubber granules for sports and leisure flooring with the base polymer EPDM are often referred to simply as EPDM granules. This term suggests that these rubber granules consist only of EPDM. However, EPDM granules are what is known as compounds, which consist of several ingredients. This technical paper clarifies the term "EPDM granules" and explains the typical composition of EPDM granules, as well as the functions of the different ingredients comprised by the granules.

Introduction

Rubber granules for sports and leisure flooring with the base polymer EPDM are often referred to simply as "EPDM granules". However, this common designation is imprecise and not quite correct. Due to the mixture of different raw materials, EPDM granules are rather a composite material (so-called compound) with the primary raw material EPDM. The term "EPDM compound granules" would therefore be more accurate. In this context, the term "compound" signifies a combination or mixture of elements or ingredients. Compounding refers to the process of refining synthetic materials by adding additives for the specific purpose of optimizing the material properties. The compounding process, which consists of several processing steps, takes place primarily in extruders (twin-screw extruders, planetary roller extruders and co-kneaders). In the broadest sense, "compounding" also means preparation or refinement.

Typical composition of EPDM granules for sports and leisure flooring

EPDM granules for sports and leisure flooring typically consist of the following ingredients:



If EPDM granules for sports and leisure flooring actually consisted of 100% EPDM, the final product would lack important properties that are crucial for the intended final application and which are assured only by the addition of other ingredients. The quality and quantity of the above-mentioned ingredients directly affect the properties of the final product. In addition, EPDM granules consisting of 100% EPDM could not be manufactured at a marketable price. Therefore, the best possible composition of the raw materials is

always balancing of costs and performance and the know-how of the optimal selection and composition of raw materials is crucial for high-quality EPDM granules.

Function of EPDM in an EPDM compound

Image 1:
Example of a pure high-quality EPDM

Ethylene propylene diene rubber (EPDM) is one of the most important synthetic rubbers. EPDM is the base material for EPDM compound granules for sports and leisure flooring and is therefore the reason for the commonly used term "EPDM granules". Among the ingredients used in EPDM granules, EPDM of the required quality is a comparatively expensive raw material, which is contained in large quantities in EPDM granules.

As a matrix material, EPDM is the main component that gives EPDM granules their properties and holds everything together. Cross-linking (vulcanization, usually with sulfur) gives the rubber compound its final property profile and its durability.

The type and quality of EPDM rubber that is used, together with the EPDM content in the final product, are decisive for the quality of EPDM granules. At low-priced granules, high-quality EPDM is often saved by partially replacing it with other, unsuitable polymers. Inferior EPDM granules can be offered at a lower price, simply due to their inferior ingredients.

For more information on the function of EPDM in EPDM granules and the difference between a polymer and an EPDM, please refer to the Technical Paper "The difference between polymer content and EPDM content".

Function of fillers in an EPDM compound

Image 2:
Chalk is a typical filler in EPDM granules

EPDM granules for sports and leisure flooring generally contain an inorganic natural filler in the form of calcium carbonate (commonly known as chalk). The filler affects the haptic experience and properties of the finished EPDM granules. It also ensures optimal adhesion of the polyurethane binder during processing and enhances the weight properties of the granules. In addition, fillers are a cost-optimized means of ensuring the volume of an EPDM granule. Fillers are the least expensive raw material in EPDM granules, but also make up the majority of the content.

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Function of sulfur in an EPDM compound

Image 3:
Sulfur as a proven crosslinking agent to produce stable rubber granules

Sulfur functions as a cross-linking agent in the manufacture of EPDM granules. In the vulcanization process, sulfur brings about the chemical cross-linking of EPDM granules. During vulcanization, the cross-linking of sulfur bridges creates links between the single hydrocarbon chains of the EPDM and modifies the rubber to make it durable and elastic. This cross-linking process is essential for a stable, very elastic product, which is commonly known as "rubber". Instead of sulfur, other materials, such as peroxide, can be used for cross-linking. However, the use of sulfur has proven itself and the cross-linking process with sulfur as a cross-linking agent is highly controllable.

Function of color pigments and master batches in an EPDM compound

Image 4:
A cut EPDM granule in which the continuous coloring is clearly visible

Image 5:
Various color masterbatches in form of granules

High-quality rubber granules are fully dyed through, which means they have a uniform color throughout and are not only colored with a surface coating. This can be proved by cutting through a single rubber granule. Fully dyeing of EPDM granules is achieved by the addition of color pigments and color master batches[1] during the compounding process. The dyes are organic or inorganic, depending on the color.

Color pigments and color masterbatches make up a small proportion in comparison to the other ingredients, but are often the most expensive raw material in an EPDM granule. In addition to the EPDM, they therefore have a major influence on the price of an EPDM granule.

Function of oils in an EPDM compound

Usually, paraffinic oil is used in the manufacture of EPDM granules. It is an organic oil that is highly compatible with EPDM. Paraffinic oil serves as a processing aid in the production process of EPDM granules for sports and leisure flooring, and for regulating the hardness of the finished granules. It is therefore often referred to as plasticizer oil. Despite of this designation, paraffinic oil of suitable quality is absolutely harmless and safe.

For the production of high-quality EPDM granules, superior paraffinic white oils are used. Due to their higher hydrogenation, white oils are completely free of aromatic hydrocarbons, which means they are harmless

[1] The term color master batch designates processed raw pigments on a polymer substrate material (usually in granular form). They are easier to handle than pastes, powders or liquid additives.

to humans. White oils are colorless and odorless, and their fully saturated structure means they have better aging properties.

Function of additives in an EPDM compound

Additives give the final product certain properties, such as UV stabilization or fire-retardant properties. They are added to the EPDM granules based on the requirements of the final product. Additives can also serve as processing aids in the production process.

Lessons learned

- EPDM granules are composed of different raw materials and contain EPDM only as a primary material.
- The commonly used term "EPDM granules" is imprecise – "EPDM compound granules" is more accurate.
- EPDM and dyes are the most expensive ingredients used in EPDM granules.
- EPDM is the component that holds everything together in EPDM granules.
- The combination of different ingredients is necessary to give EPDM granules the properties needed for the intended final application.
- The quality and quantity of the ingredients is decisive for the quality and price of finished EPDM granules.
- Expertise about the individual raw materials and their best possible composition is decisive for high-quality EPDM granules.

Index of relevant terms

Coating	Surface coating of rubber granules with colored polyurethane
Compound	Composite material consisting of different raw materials
Compounding	Process of refining synthetic materials by adding aggregates; "preparation"
EPDM	Short for ethylene propylene diene rubber; one of the most important synthetic rubbers
EPDM (compound) granules	Rubber granules comprising several ingredients with EPDM as the base material; commonly referred to as EPDM granules
Extruder	Conveying devices that press the solid or viscous masses through a shape-giving opening evenly under high pressure and at a high temperature. This process is known as extrusion.
Color master batch	Granules with a high dye content for coloring synthetic products.
Vulcanization	Process in which rubber is made durable by means of pressure and heat. The end product of vulcanization is rubber.