

Titanium Dioxide in Plastics

– Abstract of the results from the analysis regarding plastics processing, the quantities of plastics waste and the recovery of plastics waste in Germany in 2017 –

Globally, manufacturers of plastics and also of paints and varnishes, food, cosmetics or pharmaceutical products process several millions of tonnes of titanium dioxide (TiO₂) every year. The EU Commission is still pursuing its goal of classifying titanium dioxide as a potentially carcinogenic substance in Annex VI of the CLP Regulation, although several member states have expressed their disagreement to do so in the responsible REACH Committee. Also the German representatives refuse such harmonised classification of titanium dioxide. Besides the manufacturing of products containing TiO₂, such classification of titanium dioxide would have implications on the handling of waste.

Accordingly, a stricter classification of titanium dioxide would have significant consequences for the entire process chain, from plastics processing to the mechanical recycling of plastics waste. It was therefore necessary for both the plastics industry and the waste management and recycling businesses to obtain clarity on the involvement by a presently discussed TiO₂ classification and to analyse and quantify the concentrations in plastics manufacturing and plastics waste. Concrete data for Germany have been collected for the first time as part of this study.

The study on hand has been conducted on behalf of **BKV GmbH** (expert platform of the German plastics industry) and its sponsoring associations **PED** (PlasticsEurope Deutschland e.V., the association of the plastics manufacturers in Germany), **VDMI** (Verband der Mineralfarbenindustrie e.V., the German association for the producers of pigments, fillers, masterbatches and others), **AGPU** (Arbeitsgemeinschaft PVC und Umwelt e.V., the association of PVC and the environment), **GKV** (Gesamtverband Kunststoffverarbeitende Industrie e.V., the German association of plastics converters), **BDE** (Bundesverband der Deutschen Entsorgungs-, Wasser- und Rohstoffwirtschaft e.V., the federation of the German waste, water and raw material management industry), **bvse** (Bundesverband Sekundärrohstoffe und Entsorgung e.V., the association on waste management and recycling) and provides detailed results with regard to the use of titanium dioxide in plastics processing and the correlating penetration in the plastics waste.

In addition to a comprehensive secondary analysis and to identify the data, the main players along the value chain have been integrated into the study by approximately 50 expert interviews.

Primary analysis with stakeholders from the sectors

- **Plastics manufacturers** of the various applications
 - Packaging
 - Construction
 - Automotive
 - Electrical and electronics
 - Agriculture
 - Other
- **Titanium dioxide producers**
- **Plastics producers/ masterbatch producers**
- **Compound manufacturers**
- **Recyclers**
- **Waste management companies**

In this context, the following aspects became evident.

In the plastics processing sector, homogeneous and clearly identifiable product applications can be delimited. In the plastics waste sector, however, inhomogeneous waste flows with – in some cases – a higher share of extraneous materials are primarily relevant. Moreover, no secondary waste analyses have been conducted that list TiO₂ as a component. As a consequence, a model calculation has been

developed for calculating the titanium dioxide share in plastics waste. As a basis for analysing titanium dioxide in plastics processing, the plastics applications and quantities from the substance flow illustration for plastics in Germany “Stoffstrombild Kunststoffe in Deutschland 2017” has been used (Conversio, 2017). For the calculations of the plastics waste in the construction sector, further internal analyses were taken as a basis. The analysis of the plastics waste amounts with statements on titanium dioxide contents were primarily derived on the basis of the results obtained from the primary analysis as well as conclusions by analogy on part 1 of the study dealing with titanium dioxide in plastics processing. All data included in this report is based on model calculations, scientific publications (e.g. Statistisches Bundesamt, the Federal statistics agency) and expert assessments.

Part 1

- Processing of titanium dioxide in plastics products
 - Packaging
 - Construction
 - Electrical/ electronics industry
 - Automotive, agriculture, other

Part 2

- Plastics waste quantities and management of plastics waste containing titanium dioxide
- Detailed consideration of construction waste

Titanium dioxide in plastics processing

The results of the study reveal that, in Germany, about 142 kt of TiO₂ were processed in 14.4 million tonnes of plastic products in 2017. In Germany, the consumption adjusted by exports and imports amounts to a total of approximately 11.8 million tonnes of plastics, which contain ~120 kt of TiO₂. Related to all plastic applications, this results in an average TiO₂ content of about 1%. Overall, more than 60% of the entire TiO₂ quantity in plastics applications is processed in the construction and packaging applications.

Plastics processing in 2017	Plastics* [in kt]	Ø share of TiO ₂ [in %]	Amount of TiO ₂ [in kt]	Plastic amount TiO ₂ <1% [in kt]	Plastics amount TiO ₂ ≥1% [in kt]
Packaging	4,378	0.9%	37	1,993	2,385
Construction	3,520	1.5%	52	1,522	1,998
Automotive	1,611	0.5%	8	1,379	232
Electrical/ electronics	901	1.2%	11	430	471
Agriculture	568	1.2%	7	239	329
Other**	3,392	0.8%	27	2,035	1,357
Total	14,370	1.0%	142	7,598	6,772

* Used quantity includes virgin plastics (virgin materials) and recycled materials

** Others include: household articles, sports / games / leisure, furniture, medical products

Of the total amount of 14.4 million tonnes, almost 50 percent features TiO₂ contents ≥1%. Especially in the packaging sector (white plastics packaging made of PS as well as PP and PE film, PE-HD bottles), in the construction sector (PVC window profiles and floorings), in electrical/ electronical products (white goods, cable coating), as well as in other sectors (medical engineering, furniture ironmongery), TiO₂ concentrations exceeding > 1% are contained in plastics. In white plastics profiles or PVC window profiles, for example, TiO₂ contents ranging between 3 and 5% are quite common. Moreover, higher TiO₂ contents can be achieved in products with special requirements (higher absorption capacity of ultraviolet radiation).

In the packaging sector, (dyed through) white deep-drawing applications such as cups and trays, but also other applications such as hollow articles and films typically feature TiO₂ contents between 1 and 4% (in exceptional cases of very thin, opaque white films, up to 10%).

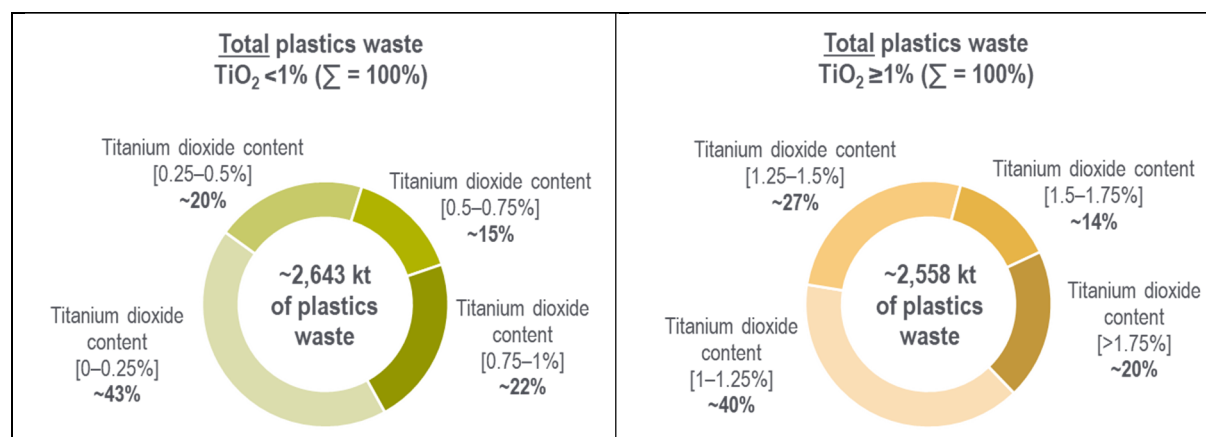
In the agricultural sector, silo and silage films with TiO₂ contents of 2–4% are typically used.

Titanium dioxide in plastics waste

Plastics production amounts and plastics waste quantities vary in terms of structure, depending on the area of application, due to the different useful life of the products.

Plastics waste in 2017	Plastics waste [in kt]*	Ø share of TiO ₂ [in %]	Amount of TiO ₂ [in kt]	Plastics waste TiO ₂ <1% [in kt]	Plastics waste TiO ₂ ≥1% [in kt]
Packaging	3,081	0.9%	28	1,479	1,602
Construction	495	1.1%	6	238	257
Automotive	232	0.3%	1	200	32
Electrical/ electronics	307	0.9%	3	166	141
Agriculture	277	1.3%	4	116	161
Other	809	0.7%	6	445	364
Total	5,201	0.9%	46	2,643	2,558

* Substance flow illustration of plastics in Germany in 2017; internal analyses on plastics waste in the construction sector (Conversio, 2016–2018)



Overall, about 5.2 million tonnes of post-consumer plastics waste accrues in Germany every year. Here, the titanium dioxide’s average share of plastics waste is of approximately 0.9% and slightly below the share of 1.0% in processing. One of the reasons for the slightly higher share in processing is the titanium dioxide’s share in durable construction products that has increased over the last years and decades. Across all plastics waste applications, about 46 kt of TiO₂ contained in plastics waste are recorded and recovered.

In the packaging sector, over 2.5 million tonnes of plastics waste show average TiO₂ contents exceeding ≥1%. The sorting, separation, and treatment of lightweight packaging may in some cases lead to a concentration of plastics waste with TiO₂ contents ≥1%. In further recycling processes with resorting, separation of plastics types, colour sorting etc., sorting fractions such as PE-LD, PE-HD, PP, and PS may contain higher TiO₂ concentrations (1–3%). This would concern approximately 0.4 million tonnes of mono-fractions that are already recycled today.

In the construction field, about 0.5 million tonnes of plastics construction waste are generated. This waste contains about 6 kt of TiO₂, half of which stems from profiles, e.g. PVC window profiles. Here, the titanium dioxide share usually ranges between 3 and 5%. With a value of >60%, the recycling of PVC window profiles exceeds the recycling rates of the remaining construction waste. More than 90% of all recycled plastics profile waste features an average TiO₂ content of at least $\geq 1\%$.

Surveys conducted among plastics manufacturers within the framework of the study prove the expectation that classification causes the range of applications of plastics products to be massively restricted.