

RECENT RESEARCH ON UV-328 FURTHER PROVES ITS POTENTIAL TO UNDERGO LONG-RANGE TRANSPORT, BIOACCUMULATE, AND CAUSE HARM

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BACKGROUND

UV-328 is manufactured at annual global production volumes exceeding 1 000 tons (UNEP/POPS/POPRC.17/4). It is used as a UV absorber, i.e., to protect against degradation from sunlight. It is used in plastics and cosmetics and is part of several consumer products including coating products, adhesives and sealants, sunscreen, food contact materials, and plastics.

In Europe, UV-328 is identified as a substance of very high concern (SVHC), requiring authorization before usage. Chemicals that are on this list have properties that can cause serious and lasting effects on human health and the environment. UV-328 is included on this list since it is a very persistent, very bioaccumulative (vPvB) chemical, as well as a persistent, bioaccumulative and toxic (PBT) chemical (ECHA, 2014, 2020).

Currently it is being assessed as a persistent organic pollutant (POP), to be included in the Stockholm convention for reduction or elimination. In 2021 the

POPs Review Committee concluded that all criteria in Annex D are fulfilled, meaning that it is persistent, bioaccumulating, has a potential for long-range environmental transport and negatively affects humans and/or the environment. The next step is for the committee to adopt the risk profile and decide “whether the chemical is likely, as a result of its long-range environmental transport, to lead to significant adverse human health and/or environmental effects, such that global action is warranted”.

There are increasing data supporting the listing of UV-328 and this research brief summarizes research that IPEN has conducted during 2021, along with other recent scientific findings on UV-328.

RECENT FINDINGS ON UV-328 AND HUMAN HEALTH

UV-328 is a persistent, bioaccumulative and toxic chemical. Earlier assessments have shown that, in mammals, UV-328 can cause adverse effects for several organs including the liver and kidneys. Repeated oral administration has been shown to lead to necrosis and proliferation of bile duct epithelia in the liver. For

SUMMARY OF IPEN DATA ON UV-328 2021-2022



TOYS

Twenty-two toys from Russia, Indonesia, and China were analyzed. All contained UV-328 and the concentrations ranged from 20 to 46 822 µg/kg (Appendix 2).

HAIR ACCESSORIES

Six hair accessories from China, Indonesia, and Russia were analyzed for UV-328. The results showed that UV-328 was present in all samples in ranges from 272-984 µg/kg (Appendix 2).

BEACHED PELLETS

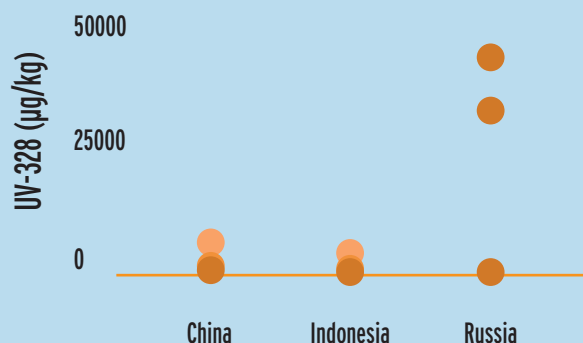
Beached pellets from 22 different countries were analyzed. UV-328 was present in 92% (101/110) of the samples in concentrations ranging from 2-883 µg/kg (Karlsson, 2021).

RECYCLED PELLETS

24 samples of recycled pellets were collected in 23 countries. 71% of the samples contained UV-328 in concentrations ranging from 0.1-334 µg/kg (Brosché *et al.*, 2021).



TOYS

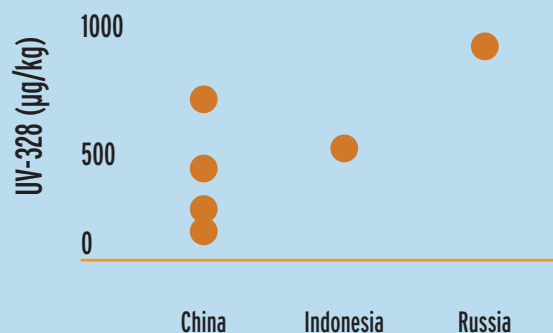


20 - 46,822
µg/kg

UV-328
found in all
22 items



HAIR ACCESSORIES



272 - 984
µg/kg

UV-328
found in all
6 items

the kidneys the same treatment was reported to lead to tubular necrosis (ECHA, 2013, 2014). UV-328 is an endocrine-disrupting chemical. Zhuang *et al.* have shown that metabolic activity can promote antiandrogenic effects and link them to potential adverse effects on sex differentiation in animal systems (Zhuang *et al.*, 2017). Recent research has further evidenced its role as an endocrine disruptor since it can act as an estrogen receptor (beta) antagonist in humans (Sakuragi *et al.*, 2021). The endocrine system is critical in multiple physiological and biological functions including reproductive functions, development of the brain and the body, and metabolic adjustments to different nutritional demands. Disruptions to the endocrine system can therefore have several consequences including infertility, sleep disorders, and neurodevelopment and growth disturbances (Flaws *et al.*, 2020).

Furthermore, studies have shown that the rates of excretion and metabolism of UV-328 in humans is low (Denghel *et al.*, 2021). Since the chemical can also bind to blood proteins (Zhuang *et al.*, 2016) this indicates a potential for bioaccumulation in humans (UNEP/POPS/POPRC.17/4).

UV-328 is frequently used in consumers products such as packaging and sunscreen. It is also common in recycled consumers products as evidenced by a global

sampling of recycled plastic pellets where UV-328 was present 71% of the samples (Brosché *et al.*, 2021).

UV-328 was also analyzed in hair accessories and toys from Russia, China, and Indonesia (see Appendix 1 for method description). Amongst the toys, all 22 items contained UV-328 in the range of 20 to 46 822 µg/kg. The highest concentrations were found in a “Rubik’s cube” type of toy and a toy gun, both purchased in Russia. All hair accessories also contained UV-328 in concentrations between 272-984 µg/kg.

Since UV-328 is known to leach out of plastic products, has potential to accumulate in humans, can act as an endocrine disruptor and has toxic effects on the liver, its presence in children’s toys is deeply concerning. Children are especially vulnerable because endocrine-disrupting chemicals can affect their development and growth. They also tend to put toys in their mouth, potentially leading to an increased exposure to the chemicals in the products through migration into saliva.

RECENT FINDINGS ON THE ENVIRONMENTAL PRESENCE OF UV-328

UV-328 is a persistent chemical with a half-life of several months. Its presence has been documented in the

environment since the late 1970s (Apel *et al.*, 2018; Jungclaus *et al.*, 1978; Kameda *et al.*, 2011; Kim *et al.*, 2011; Montesdeoca-Esponda *et al.*, 2020; Montesdeoca-Esponda *et al.*, 2021), including in beached plastic litter (Rani *et al.*, 2017; Santana-Viera *et al.*, 2021; Tanaka, Takada, *et al.*, 2020).

Together with International Pellet Watch, IPEN analyzed UV-328 in plastic pellets collected on beaches in 22 different countries. Plastic pellets are millimeter-sized plastic pieces used to make plastic products. The results showed that UV-328 was present in samples from all locations. For each location five subsamples were analyzed and UV-328 was present in 92% of the subsamples (101/110) (Karlsson *et al.*, 2021). Its presence is likely due to a combination of the chemical being used as an additive and of it sorbing (attaching) to the plastic pellets in the marine environment.

Plastic particles are frequently ingested by marine organisms and birds; 180 bird species have been documented to ingest plastic particles (Kuhn and Franeker 2020). Recent studies have shown that UV-328 is also frequent in seabirds and the leaching of UV-328 from ingested plastic particles has been identified as a significant exposure pathway to the chemical (Tanaka, Watanuki, *et al.*, 2020; Yamashita *et al.*, 2021).

RECENT FINDINGS ON THE LONG-RANGE TRANSPORT OF UV-328

UV-328 can undergo long-range transport through atmospheric transport processes as well as transport by migratory species, i.e., birds. Additionally, it can undergo oceanic long-range transport when associat-

ed with (i.e., adsorbed or intentionally added) floating plastics.

The long-range transport of floating plastics with ocean currents across national boundaries has been well documented over the past 50 years (e.g. Carpenter & Smith, 1972; Onink *et al.*, 2021; van der Mheen *et al.*, 2020; Van Sebille *et al.*, 2015; Venrick *et al.*, 1973; Wong *et al.*, 1974). A recent global estimate suggests that 8 100-18 900 tons of additives (Andrade *et al.*, 2021) are transported

together with the floating plastics. A significant portion of those is transported to the Arctic (Andrade *et al.*, 2021). IPEN analyzed beached plastic pellets in 22 countries from all over the world and found UV-328 in pellets from all locations (Karlsson, 2021). Evidence of long-range transport is further supported by the findings of UV-328 in remote locations (Yamashita *et al.*, 2021).

Yamashita *et al.* analyzed 145 preen gland oil samples in 32 species of seabirds from several remote islands and locations spread across the globe (including Marion Island, St. Lawrence Island, and Kerguelen Island) and found that high concentrations of additives were found in species with high levels of plastic ingestion (Yamashita *et al.*, 2021). Studies on seabirds have shown that UV-328 can leach from plastic pellets upon ingestion and accumulate in the liver and adipose tissue (Tanaka, Watanuki, *et al.*, 2020), thus further proving the propensity for plastic particles to act as carriers for UV-328.

Plastic waste washed up on shore in Guinea. Photo: Carbone Guinéé



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Cite this publication as:

Karlsson, T., Miller, P., Brosché S. *Recent research on UV-328 further proves its potential to undergo long-range transport, bioaccumulate, and cause harm.* International Pollutants Elimination Network (IPEN), January 2022.

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ACKNOWLEDGEMENTS

Samples were provided by IPEN Participating Organizations Eco-Accord, Russia; Nexus3, Indonesia; Toxics Free Corps, China. Laboratory analyses were coordinated by Arnika – Toxics and Waste Programme and performed at the Department of Food Analysis and Nutrition, University of Chemistry and Technology Prague, the Czech Republic. The authors are also grateful to Jitka Straková for her input.

IPEN would like to acknowledge that this document was produced with financial contributions from the Swedish Environmental Protection Agency; the Government of Sweden; the Plastic Solutions Fund, a project of Rockefeller Philanthropy Advisors; and other donors. The views herein shall not necessarily be taken to reflect the official opinion of any of these donors.

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APPENDIX 1. METHOD DESCRIPTION FOR MEASUREMENTS IN TOYS AND HAIR ACCESSORIES

Samples of toys (22) and hair accessories (6) were collected by IPEN POs in Russia, Indonesia, and China (Figure 1). UV stabilizers were extracted from pellets using ultrasonic extraction with dichloromethane and subsequently determined using ultra-high performance liquid chromatography-mass spectrometry/mass spectrometry (UHPLC-MS/MS).



Figure 1. Examples of items in the two categories: toys and hair accessories

APPENDIX 2. RESULTS UV-328

TABLE 1. CONCENTRATIONS OF UV-328 IN DIFFERENT ITEMS PURCHASED IN CHINA, RUSSIA AND INDONESIA.

Country where item was purchased	Type of sample	Concentration (µg/kg)
China	toy	1 193
	toy	881
	hair accessory	515
	hair accessory	272
	hair accessory	787
	hair accessory	359
	toy	6 834
	toy	2 014
	toy	534

Table 1, continued next page

Table 1, continued

Country where item was purchased	Type of sample	Concentration ($\mu\text{g}/\text{kg}$)
Russia	toy	322
	toy	529
	toy	499
	toy	35 247
	hair accessory	984
	toy	41
	toy	504
	toy	46 822
	toy	519
	Indonesia	toy
toy		20
toy		343
toy		791
toy		63
hair accessory		593
toy		4 598
toy		523
toy		860
toy		1 281



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