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## RESEARCH ARTICLE

# OCCURRENCE OF MICROPLASTIC RESIN PELLETS IN SEDIMENTS AROUND AGATTI ISLAND, INDIA

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### ABSTRACT

Plastic resin pellets (0.1 to 0.5 cm in diameter) are transport medium for toxic chemicals (especially persistent organic pollutants) in the marine environment. Plastic resin pellets are worldwide persistent pollutants that accumulate in ocean, especially on sandy beaches. To improve the knowledge of occurrence of plastic resin particles and their impact on coral reef area of Lakshadweep Sea, a preliminary monitoring survey was carried out around Agatti Island in November, 2014. Pellets were classified by colour and their surface analysed by stereomicroscopy. The overall spatial distribution of pellets showed that higher occurrence of pellets was observed along the southwest part of Island. Significantly higher plastic litter accumulation was found along the western part than eastern part of island. The white coloured pellets were predominant, presenting virgin surfaces, with few signs of oxidation. This is congruent with a short residence time in the marine environment and primary sources possibly located nearby. Studies are required to correlate marine microplastic resin pellets accumulations with currents and shipping lanes to determine sources of the plastic pellets, and to target clean up and prevention efforts.

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## INTRODUCTION

Plastic resin pellets are tiny particles generally with the shape of a cylinder or disk with a diameter of few millimetres. These plastic particles are industrial raw material transported to manufacturing sites where 'user particles' are made by re-melting and moulding into the final products. Resin pellets can be unintentionally released to the environment, both during manufacturing and transport (Takada, 2006). The released resin pellets are carried by river runoff, eventually entering into the ocean. Because of their environmental persistence, they are distributed widely in the ocean and are now found on beaches all over the world. Plastic resin pellets have been found on many beaches around the world because of environmental persistence of plastic polymers, their capability for long-range transport, and increases in plastic production (Moore *et al.*, 2001; Derraik, 2002; Mc Dermid and McMullen, 2004; Ogata *et al.*, 2009; Holmes *et al.*, 2012; Zhang *et al.*, 2015).

Many researchers found that the plastic resin pellets are acting as a transport medium for toxic chemicals in the marine environment (Mato *et al.*, 2001, Ogata *et al.*, 2009). Plastic pellets sorb hydrophobic organic compounds, including persistent organic pollutants (POPs). Because of their ability to

accumulate POPs with a concentration factor of up to  $\sim 10^6$  relative to surrounding seawater, their ubiquitous occurrence on world beaches and their ease of collection and shipment, plastic resin pellets are used as passive samplers by International Pellet Watch (IPW) (Takada, 2006). Plastics that are highly degraded lose their tensile strength and become brittle enough to turn into powdery particles upon contact. Light-induced oxidation is usually orders of magnitude greater than other types of degradation. In particular, ultraviolet (UV) light is responsible for the initiation of photo-oxidative degradation, a very effective process for positively buoyant particles. The specific aims this study were (1) to establish the distribution pattern of micro plastic resin pellets, and (2) to identify the surface oxidation features of pellets around Agatti island.

## MATERIALS AND METHODS

The Lakshadweep islands (36 islands, 10 inhabited) situated off the Kerala coast are made up of coral reefs of Holocene age. Agatti island is one of the ten inhabited islands of Lakshadweep archipelago. The normal rainfall is 143.48 cm, of which 111.34 cm is contributed by southwest monsoons (June–September) (Sundaresan, 1993). Plastic resin pellet samples were collected from ten locations (S1–S10) of sandy beaches

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around Agatti island (Figure 1). We have followed a general protocol that has been described by several authors (Thompson *et al.*, 2004; Mc Dermid and Mc Mullen, 2004; Jayasiri *et al.*, 2013; Acosta-Coley and Olivero-Verbel, 2015). Samples included only microplastic resin pellets. Collected pellets were individually classified according to colour, based on recommendations in the literature (Turner and Holems 2011; www.pelletwatch.org). A total of five major categories were used, corresponding to the colours white, black, yellow, gray and blue. Once classified, pellets were weighed using an analytical balance, and their size were measured using a caliper. Final storage was in separate glass containers, by colour. Subsamples of collected pellets were used to characterise major oxidation features on the pellet surface. This was accomplished using a NIKON Stereoscopic microscope SMZ1500 coupled with a digital camera.

## RESULTS AND DISCUSSION

### Physical characteristics of pellets

A total of 2702 plastic resin pellets were collected and

classified according to colour. The frequency distribution of pellets followed the order white > black > yellow > gray > blue, with white as the most common colours at all the sampling locations. The colour frequency distribution of these resin pellets is given in Figure 2.

### Surface oxidation features of pellets

Stereoscopic analysis of pellet surfaces led to the identification of several oxidation characteristics, although most white pellet samples had a virgin surface. The most commonly observed features were virgin surface, adhesion, scales, material loss, erosion, whitening or glazed surface, cracked surface, granulation, and change in colour. Several of these characteristics were sometimes together on a single pellet. However, in most cases, the degradation process seemed to always be accompanied by change in colour, as observed by Acosta-Coley and Olivero-Verbel (2015). A detailed description of these feature is explained as follows. *Virgin surface*: These pellets have a smooth surface with no signs of erosion and are translucent and slightly striated. The pellets possess physical integrity and resistance to fragmentation. The

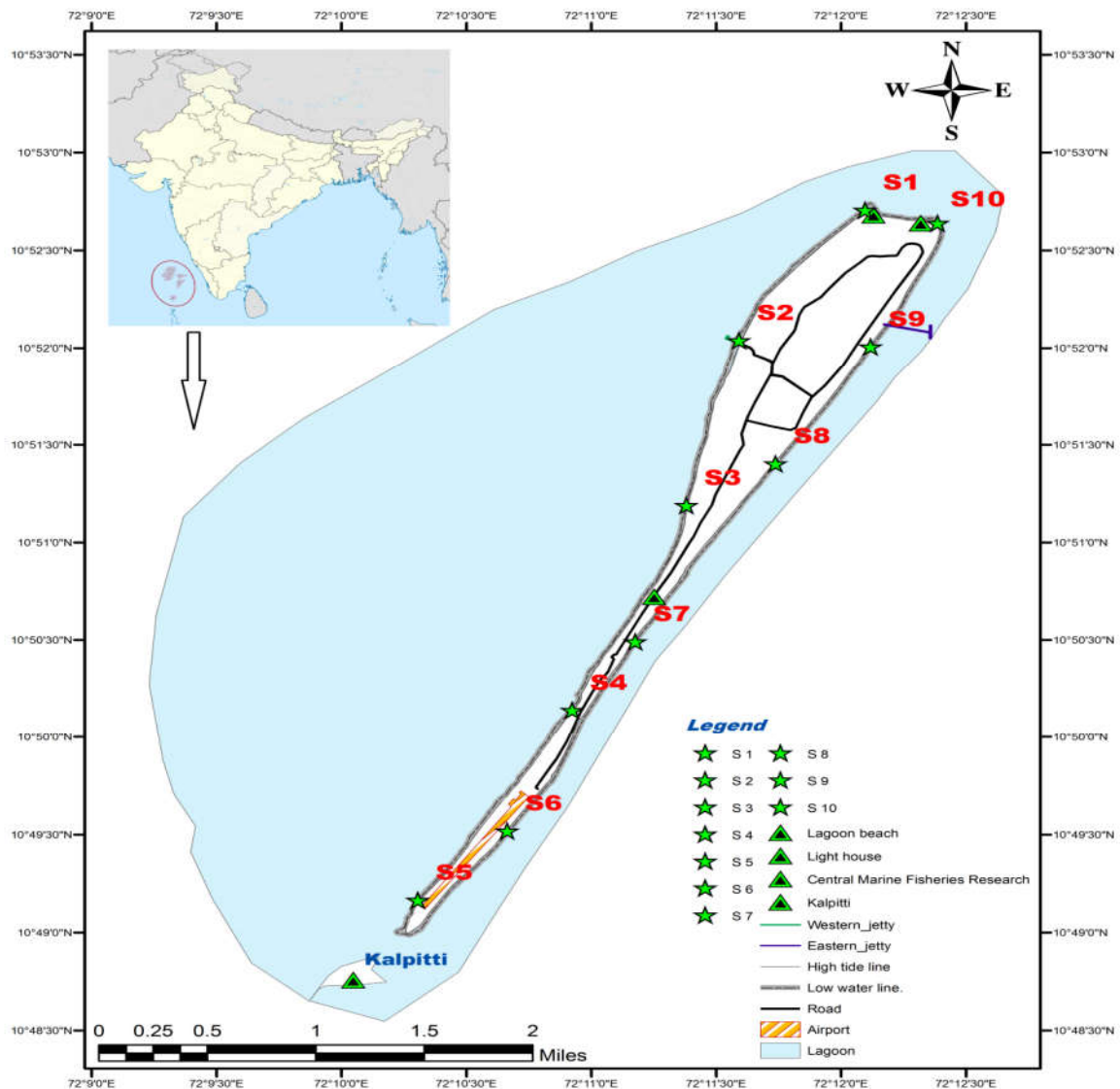


Figure 1 The sampling locations along Agatti island

collected samples were very similar to resins from plastics processing factories (Figures 3a, b).

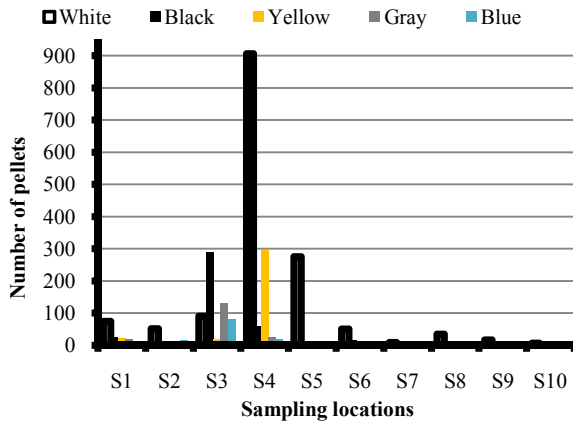


Figure 2 The distribution of plastic resin pellets along Agatti island

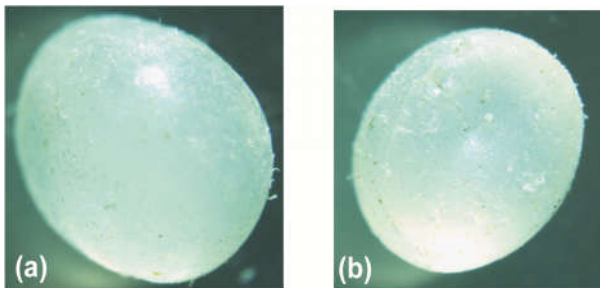


Figure 3 (a-b) Virgin resin pellets with white translucent surface

**Material loss**

Some pellets evidenced early degradation processes, which may have begun with fractures leading to fragmentation, with resultant loss of physical integrity (Figure 4a).

**Scales**

These are seen as small abrasions of the plastic material (Figure 4a), which remain attached to the pellet surface and vary in size and shape. Scales may form as a result of weathering but can also be observed on new pellets and originate from manufacturing processes.

**Adhesion**

The presence of an eroded surface on the plastic particles seems to facilitate the development of biofouling (Figure 4b). In contrast, the surface topography of virgin pellets relative to weathered ones hardly permits the establishment of any kind of material. Biogenic remains and plant residues were observed on the surface of the pellets. Moreover, the presence of cracks allowed accumulation of sand granules and other unidentified materials.

**Erosion**

A few pellet registered depressions or small holes of varying depth that made the surface irregular, conferring a wasted appearance (Figure 4b). This may result, in part, from mechanical forces leading to degradation. This type of surface

becomes susceptible to accommodating various types of particles.

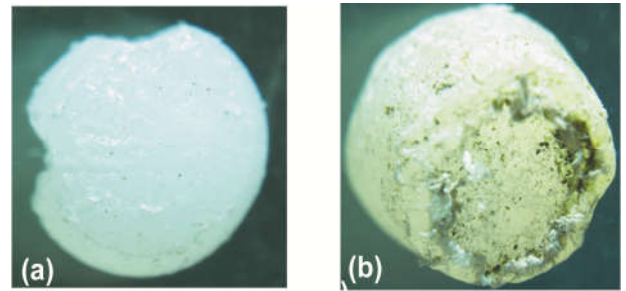


Figure 4 (a-b) Physical surface oxidation features including material loss, scales, adhesion and erosion.

**Glazed surface**

These particles present a layer with chalky appearance (Figure 5a) that may extend and progress over time, in some cases resulting in complete bleaching of the pellet. The process is likely to begin as small rusty spots like ‘patches’, which may spread to occupy the entire surface of the particle.

**Cracked surface**

Weathered pellets can exhibit several types of cracks, which may vary in size, depth, and distribution over their surfaces. Some such pellets may develop isolated cracks (Figure 5b), which are concentrically arranged or randomly distributed. It is likely that cracks in the reticulated surface eventually become fused, generating a granulated surface.

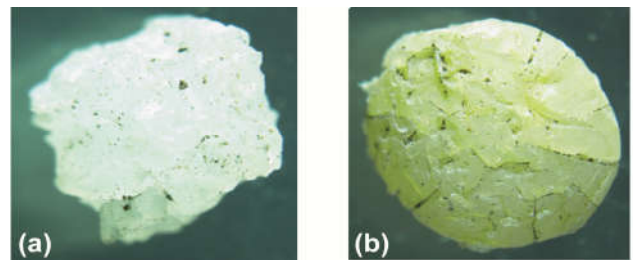


Figure 5 (a-b) Physical surface oxidation features such as glazed and cracked surfaces.

**Granular surface**

In this case, a series of small granules develop, which may extend over the pellet in different proportions, even fully occupying its surface (Figure 6a). Pellets with this type of surface have lost their plastic texture and acquire a fragile cry stalized one that is prone to break into sub- microplastics, as microscopic particles and fibres.

**Colour change**

Some pellets with a translucent surface may begin to change colour, becoming yellowish, darkening, and/or acquiring gray tones. Because of accumulated dirt, pellets sometimes develop a white, weathered appearance (Figure 6b). In the case of pigmented pellets, they usually lose some of their original colour and become lighter. Yellow and brown colours may appear as a result of photo-oxidative damage, indicative of their longevity in the marine environment.

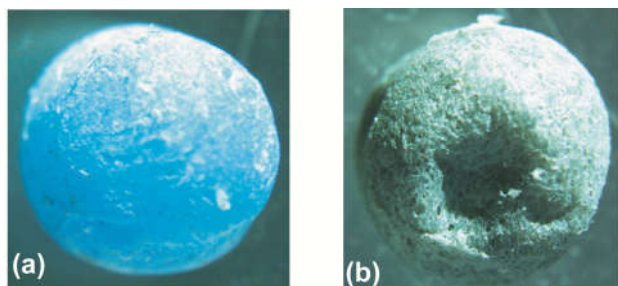


Figure 6 (a-b) Physical surface oxidation features: Granular surface and colour change.

## CONCLUSION

Microplastic resin pellets are being deposited on the beaches around Agatti island, the most important coral reef ecosystem. The most abundant pellets were white, presenting virgin surfaces reflects a short residence time in the marine environment and likely nearby sources. The surface characteristics of pellets were identified including adhesion, scales, material loss, erosion, whitening or glazed surface, cracked surface, granulation, and change in colour. The overall spatial distribution of pellets showed that higher plastic pellets accumulation was found along the western part than eastern part of island. The results from this study will be useful to monitor the impact of micro plastic resin pellets on coral reef ecosystem in Agatti Island.

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## References

1. Acosta- Coley, I., and Olivero- Verbel, J., 2015. Micro plastic resin pellets on an urban tropical beach in Colombia. *Environmental Monitoring and Assessment*, 187, 435.
2. Derraik, J.G.B., 2002. The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin*, 44, 842–852.
3. Holmes, L.A., Turner, A., and Thompson, R.C., 2012. Adsorption of trace metals to plastic resin pellets in the marine environment. *Environmental Pollution*, 160, 42–48.
4. Jayasiri, H.B., Purushothaman, C.S., and Vennila, A., 2013. Quantitative analysis of plastic debris on recreational beaches in Mumbai, India. *Marine Pollution Bulletin*, 77, 107– 112.
5. Mato, Y., Isobe, T., Takada, H., Kanehiro, H., Ohtake, C., and Kaminuma, T., 2001. Plastic resin pellets as a transport medium for toxic chemicals in the marine environment. *Environmental Science and Technology*, 35, 318–324.
6. Mc Dermid, K.J., McMullen, T.L., 2004. Quantitative analysis of small-plastic debris on beaches in the Hawaiian archipelago. *Marine Pollution Bulletin*, 48, 790–794.
7. Moore, S.L., Gregorio, D., Carreon, M., Weisberg, S.B., Leecaster, M.K., 2001. Composition and distribution of beach debris in Orange County, California. *Marine Pollution Bulletin*, 42, 241–245.
8. Ogata, Y., Takada, H., Mizukawa, K., Hirai, H., Iwasa, S., Endo, S., Mato, Y., Saha, M., Okuda, K., Nakashima, A., Murakami, M., Zurcher, N., Booyatumanondo, R., Zakaria, M.P., Dung, L.Q., Gordon, M., Miguez, C., Suzuki, S., Moore, C., Karapanagioti, H.K, Weerts, S., *et al.*, 2009. International Pellet Watch: Global monitoring of persistent organic pollutants (POPs) in coastal waters. 1. Initial phase data on PCBs, DDTs, and HCHs. *Marine Pollution Bulletin*, 58, 1437–1446.
9. Sundaresan, J., 1993. Impact of sea level rise on aquifer system of Agatti Atoll, an island of Lakshadweep Archipelago. *Environmental Geology*, 21, 51–54.
10. Takada, H., 2006. Call for pellets! International Pellet Watch Global Monitoring of POPs using beached plastic resin pellets. *Marine Pollution Bulletin*, 52, 1547–1548.
11. Thompson, R.C., Olsen, Y., Mitchell, R.P., Davis, A., Rowland, S.J., John, A.W., Mac Gonigle, D., Russell, A.E., 2004. Lost at sea. Where is all the plastic? *Science*, 304, 838.
12. Turner, A., Holmes, L., 2011. Occurrence, distribution and characteristics of beached plastic production pellets on the island of Malta (Central Mediterranean). *Marine Pollution Bulletin*, 62, 377–381.
13. Zhang, W., Ma, X., Zhang, Z., Wang, Y., Wang, J., Wang, J., Ma, D., 2015. Persistent organic pollutants carried on plastic resin pellets from two beaches in China. *Marine Pollution Bulletin*, in press.

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