STUDY OF THE DESORPTION OF NANOPARTICLES PREVIOUSLY ADSORBED ON POLYETHLENE MICROPLASTICS

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INTRODUCTION

Microplastics (1-1000 µm) are introduced into the environment through various pathways, with wastewater being one of the primary sources. In wastewater, microplastics can adsorb various pollutants, including nanoparticles. These nanoparticles can later desorb in the digestive tracts of organisms, potentially causing harmful effects.

MATERIALS & METHODS

- Nanoparticles TiO_2 and ZnO (100 mg/L) were adsorbed on polyethylene microplastics.
- Desorption was studied at pH values of 6 and 8.3, with conditions including shaking at 170 rpm, and sampling at intervals of 3, 6, 12, and 24 hours. Nanoparticle concentrations were determined using ICP-MS and ICP-OES techniques.
- The desorption kinetics were analyzed using various Lagergren kinetics models, including first-order, pseudo-first-order, and pseudo-second-order models.

INTERACTIONS

- Initial concentration of adsorbed nanoparticles on microplastics:
  $c(nTiO_2)$ = 923,7 µg/g
  c(nZnO) = 284,2 µg/g
- The maximum desorption for $nTiO_2$ was reached after 6 h (Figure 1) and for nZnO after 24 h (Figure 2).

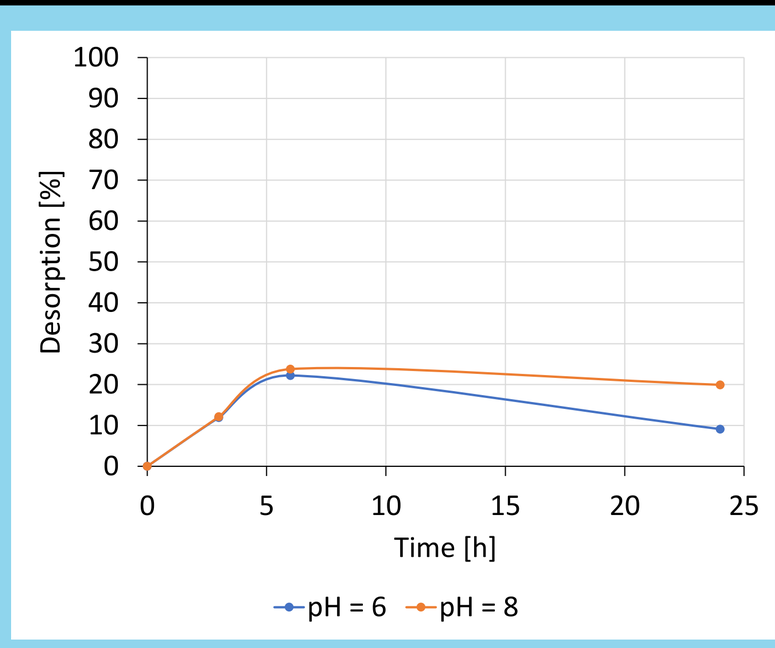

Figure 1: The desorption of $nTiO_2$ with time

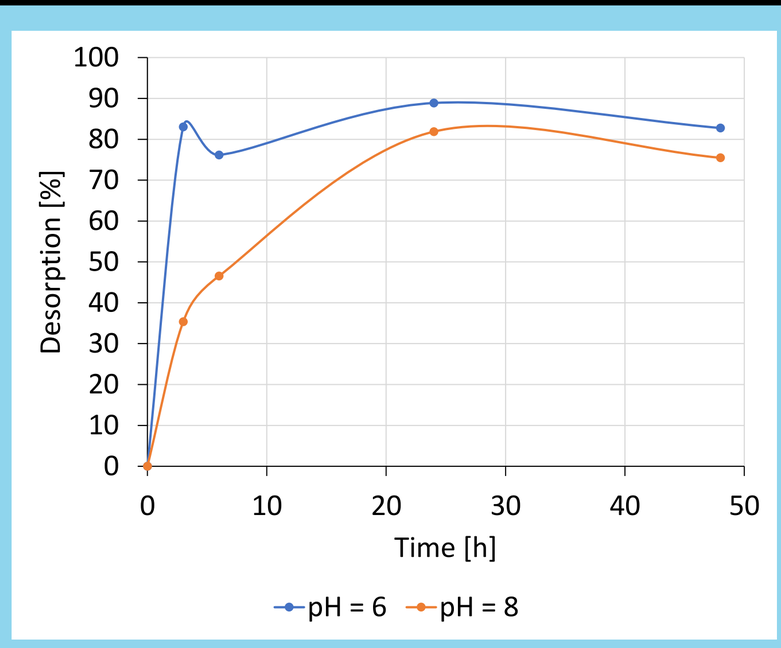

Figure 2: The desorption of nZnO with time

DESORPTION KINETICS

Table 1: Parameters for the pseudo-second-order kinetic model

	pH [/]	K_2 [g/µg·h]	$W_{e,cal}$ [µg/g]	$W_{e,exp}$ [µg/g]	R^2 [/]
TiO_2	6	0,00277	666,7	718,4	0,9977
	8	0,00336	666,7	704,0	0,9983
ZnO	6	0,0129	28,9	31,6	0,9833
	8	0,00536	45,0	51,5	0,9754

K_2 pseudo-second-order rate constant [g/µg·h]

$W_{e,cal}$ calculated desorbed concentration at equilibrium [µg/g]

$W_{e,exp}$ experimentally determined desorbed concentration at equilibrium [µg/g]

R^2 The coefficient of determination [/]

CONCLUSIONS

The study investigated the impact of pH on the desorption of nanoparticles adsorbed onto microplastics. The desorption kinetics for both $nTiO_2$ and nZnO nanoparticles were accurately modeled using the pseudo-second order Lagergren model, with a coefficient of determination (R^2) near unity. The findings indicated that pH did not influence the quantity of nanoparticles desorbed. However, the kinetic rate constants revealed that both nanoparticles desorbed more quickly at lower pH levels.