Table S1. Analyze items and test methods.

Index	Analytical method
COD	$K_2Cr_2O_7$-UV Photometric Method
NH_4^+-N	Nessler's reagent spectrophotometry
NO_3^--N	Salicylic acid spectrophotometry
NO_2^--N	Alpha-naphthylamine hydrochloride spectrophotometry

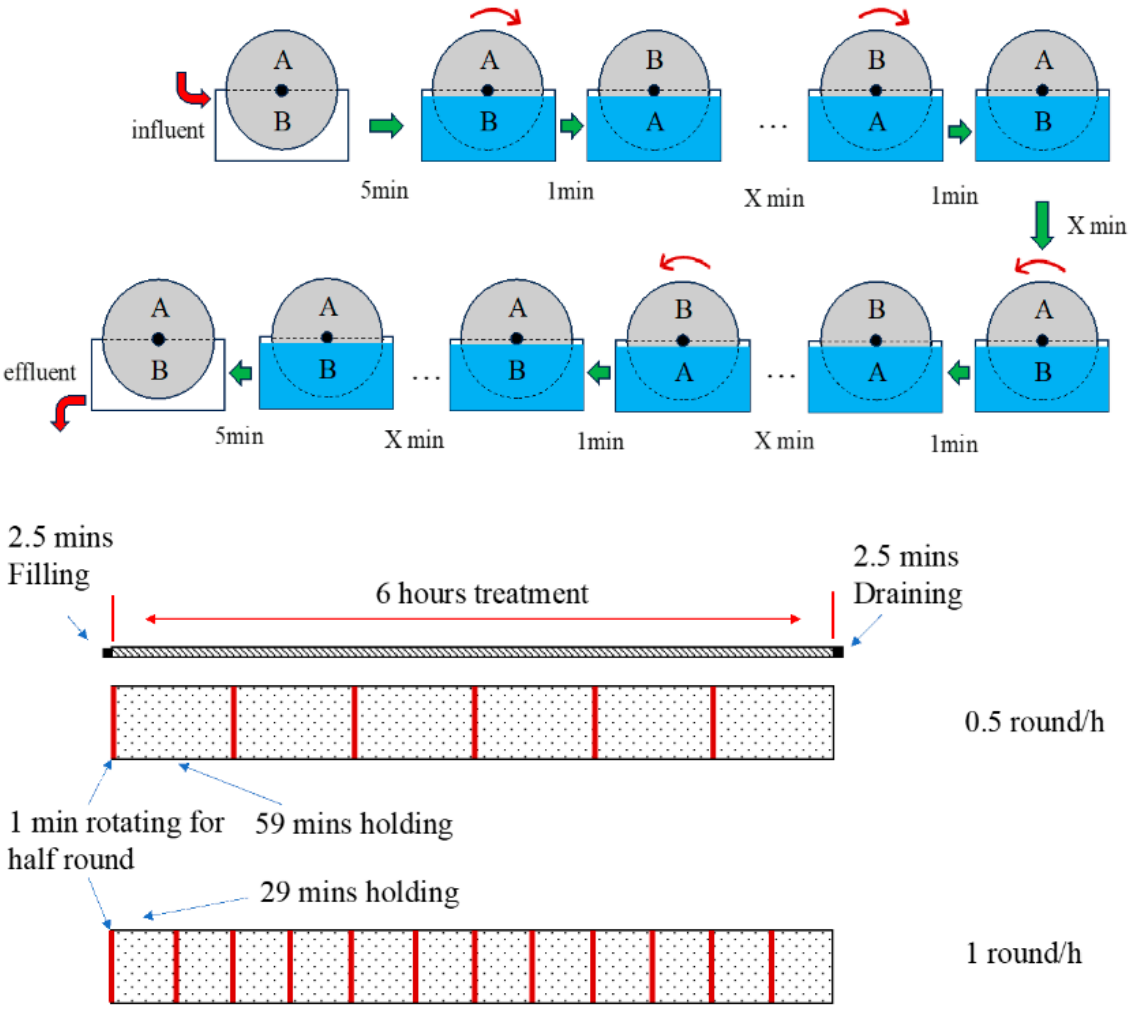

Figure S1. Illustration of rotation pattern of P-RBC reactor at rotating speed of 0.5 and 1 round per hour

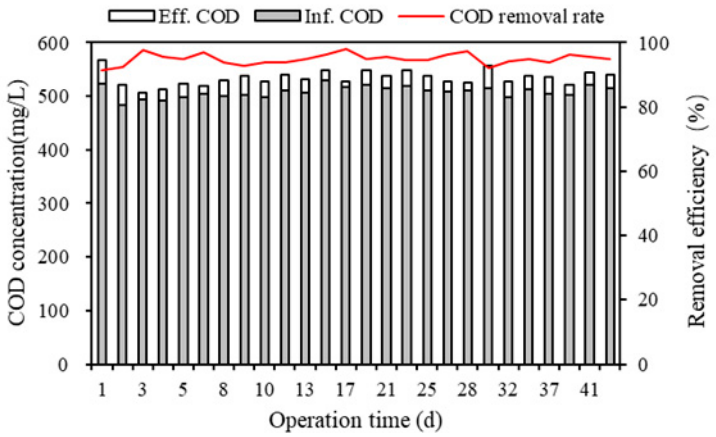

Figure S2. Long-term performance of COD removal by T-RBC

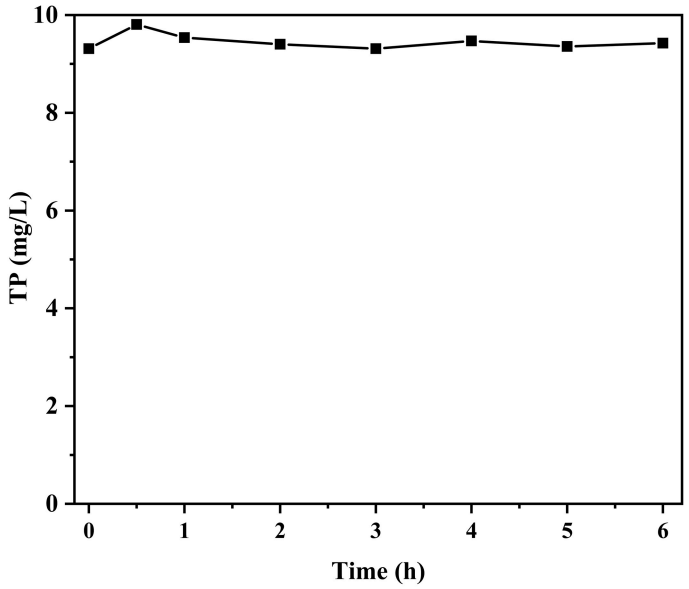

Figure S3. Total Phosphorous release profile

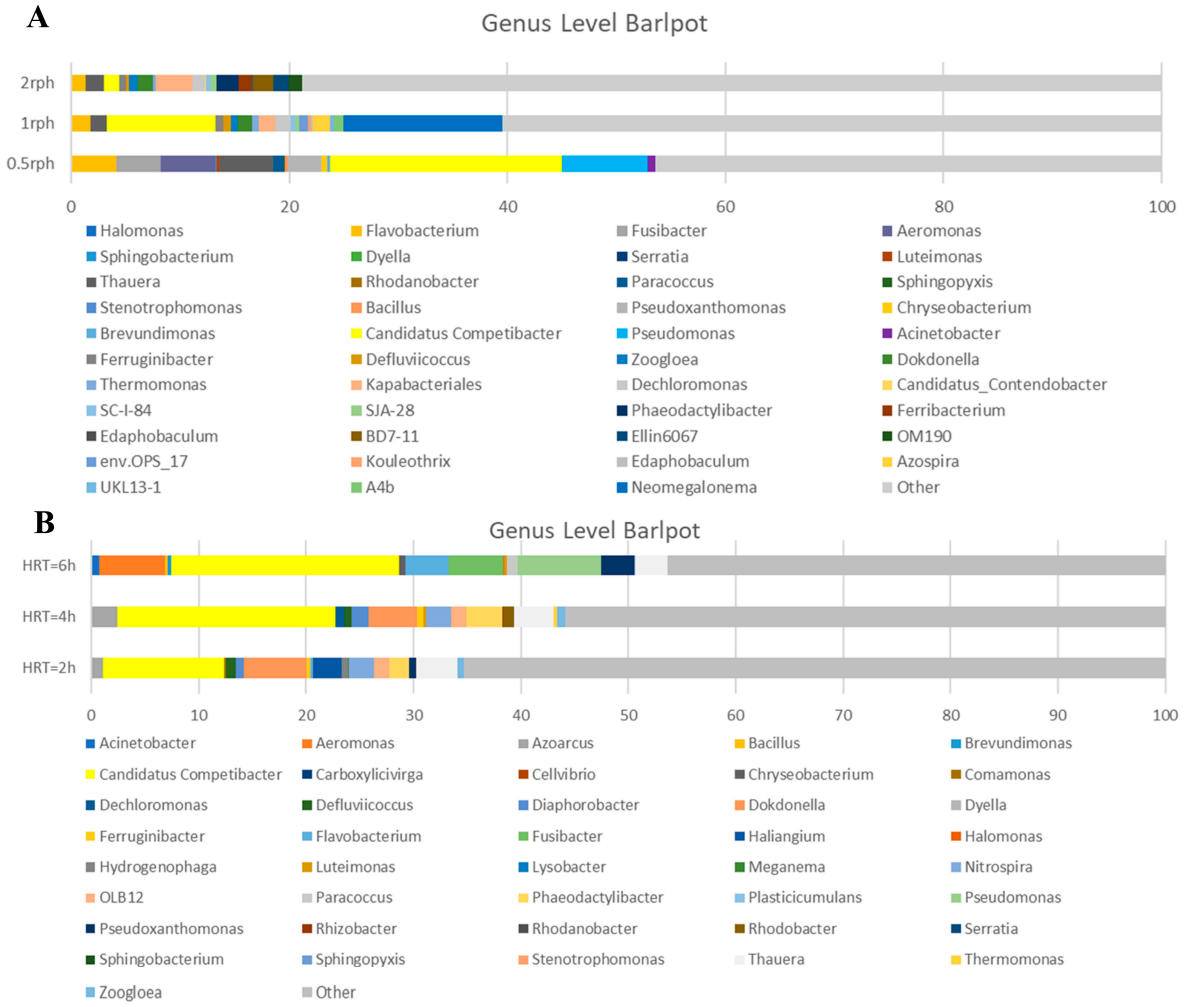

Figure S4. Microbial communities Analysis at A) different speeds; B) different HRTs

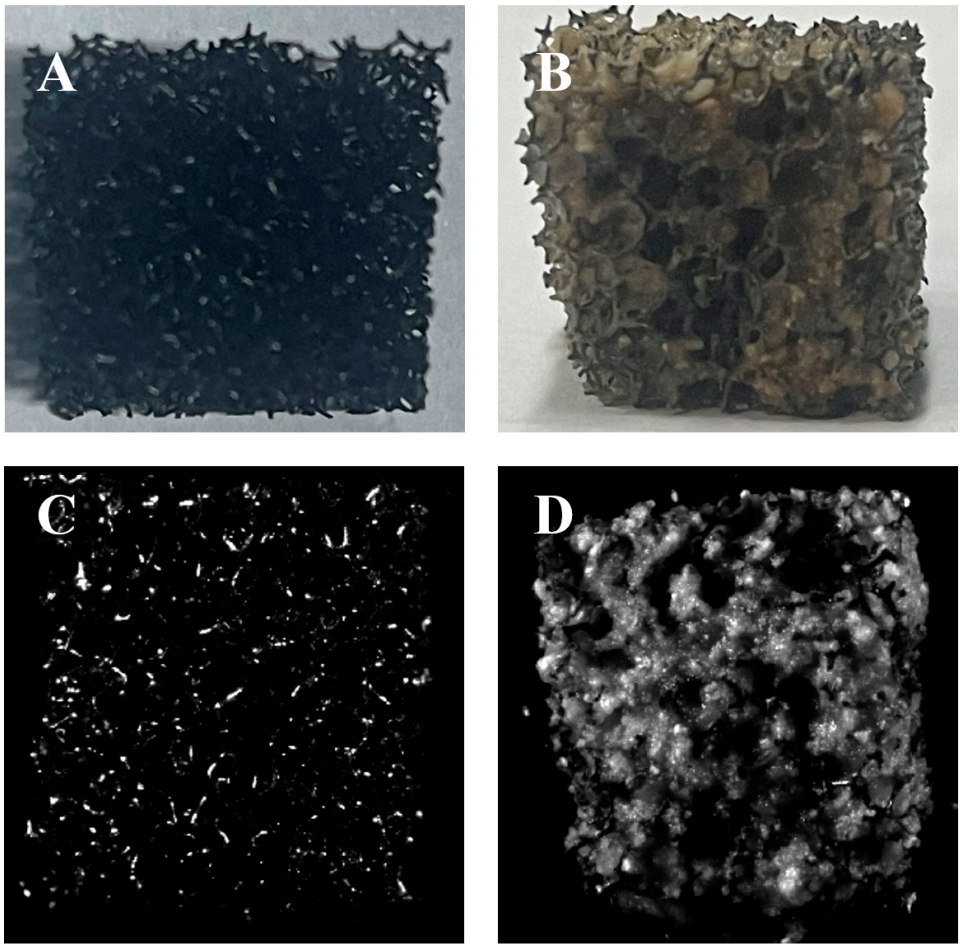

Figure S5. Camera photos of the A) Blank polyurethane biocarriers and the B) biofilm loaded biocarriers, compared to Gel electrophoresis imaging for the C) Blank polyurethane biocarriers and the D) biofilm loaded biocarriers

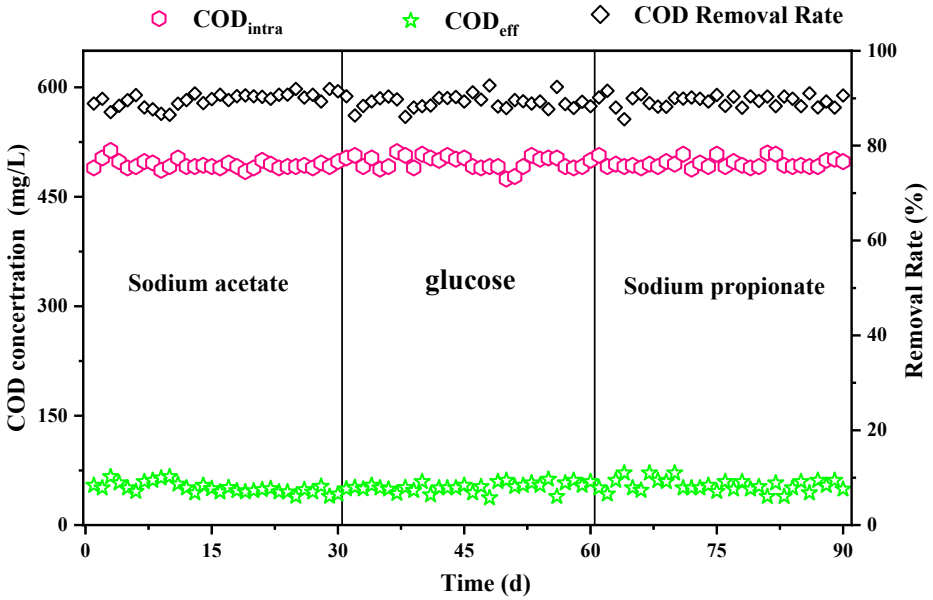

Figure S6. The COD of different carbon sources removes the long-term operation curve