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WATER MANAGEMENT IN 4 SUBJECTS 180-DAY CELSS INTEGRATED EXPERIMENT:  
CONFIGURATION AND PERFORMANCE

**Abstract**

Water recycle and management subsystem is the major component of the controlled ecological life support system (CELSS) in 4 subjects and 180-day integrated experiment (Shenzhen, China, 2016). For satisfying the water requirement of crop growth and crew's daily life (drink, food preparation, personal hygiene, underwear cleaning, urinal flush), the main role of such water subsystem is to ensure the water recycle orderly and wastewater regeneration efficiently. Water recycle and regeneration in the CELSS was designed as follows: (1) Condensate water collection and allocation. Condensate water majorly generated from plant transpiration (> 95%) was collected efficiently through temperature-humidity subsystem. It was reused primarily as plant nutrient solution after UV disinfection and minorly as the influent of domestic water supply process. (2) Domestic water purification and supply. The domestic water supply process configuring membrane biological and physico-chemical treatment units was employed to purify the condensate water from plant cabin, and then provided hygiene and potable water for guaranteeing crew's life according to different quality standards, respectively. (3) Wastewater treatment and reuse. Urine wastewater, hygiene wastewater, and condensate water from waste solid processing were treated together via biological wastewater treatment process. The effluent of this process was recycled to the plant cultivation module as crop's nutrient solution. (4) Nutrient solution regeneration. The plant nutrient solution in hydroponics system was continuously self-circulation and regenerated by UV sterilization synergy with activated carbon adsorption according to pollutant accumulation. During the 180d continuously experiment period, the water subsystem in CELSS showed good performance on water regeneration and recycle. The results demonstrated that (1) there was no additional water supplied from outside, (2) domestic water provided to 4 crews through water supply process maintained securely and sufficiently,

(3) regenerated domestic wastewater adopted by nutrient solution showed no adverse impact on 25 crops' cultivation and harvest. Additionally, there were some suggestion on water recycle and management subsystem in CELSS. Due to the harmful organic matter and inorganic salt accumulation in plant nutrient solution, for longer-term experiment bearing with more subjects, there should be some comprehensive treatment process for organic pollutants removal to guarantee the crop nutrient solution safety, and an independent urine processing module should be needed to reduce salt enrichment.