Key result n°7: Reduction of the water consumption: washing water reuse after O_3/UV treatment

Workpackage: WP4 – Optimising cleaning and disinfection processes to reduce the use of water and chlorine

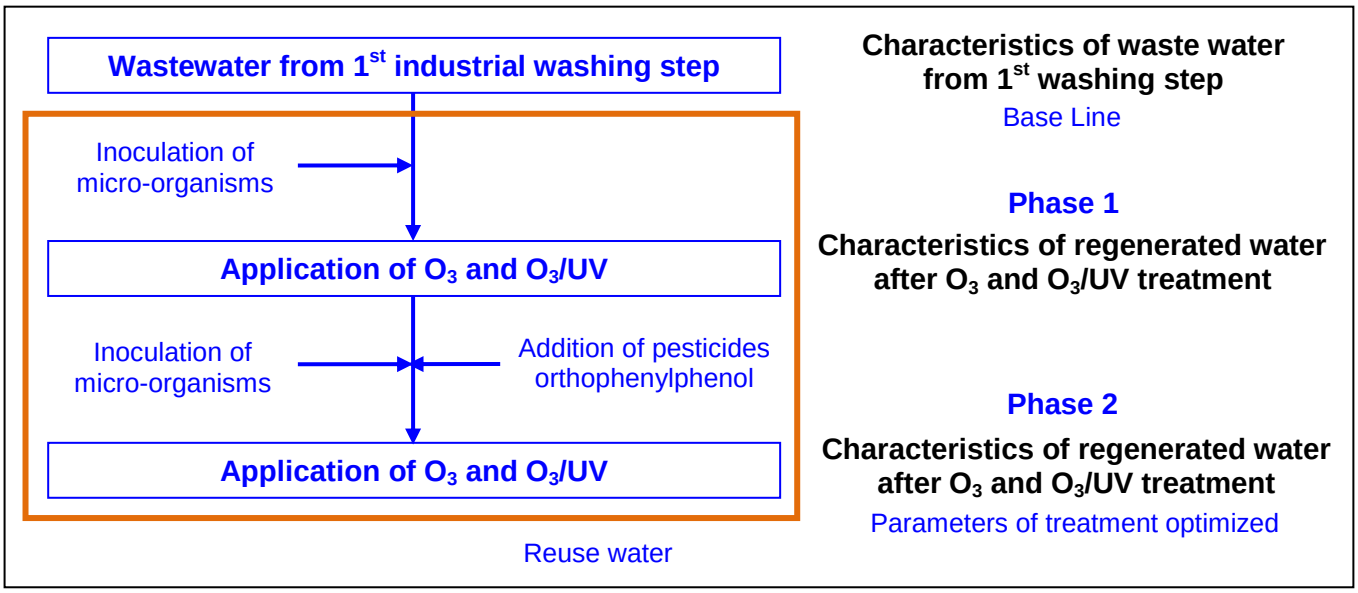

Figure 1: General methodology to validate the use of O_3 and O_3+UV as water regeneration treatment.

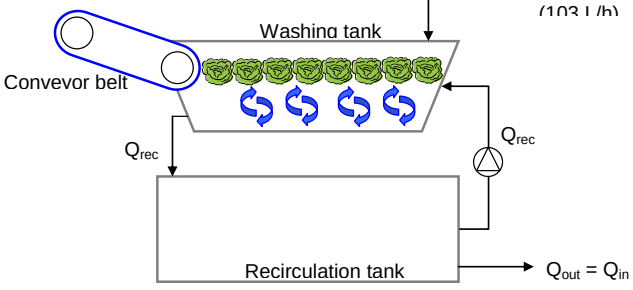

Figure 2a/ Pilot plant: simulation of washing industrial process

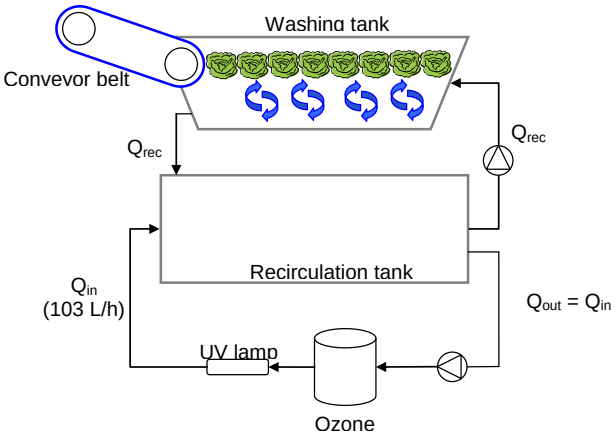

Figure 2b/ Pilot plant: washing step with a loop to treat a stream of washing water with O_3/UV

Key result n°9: LCA modelling for the decontamination and sanitation operations

Workpackage: WP5 - Environmental assessment and best practices integration

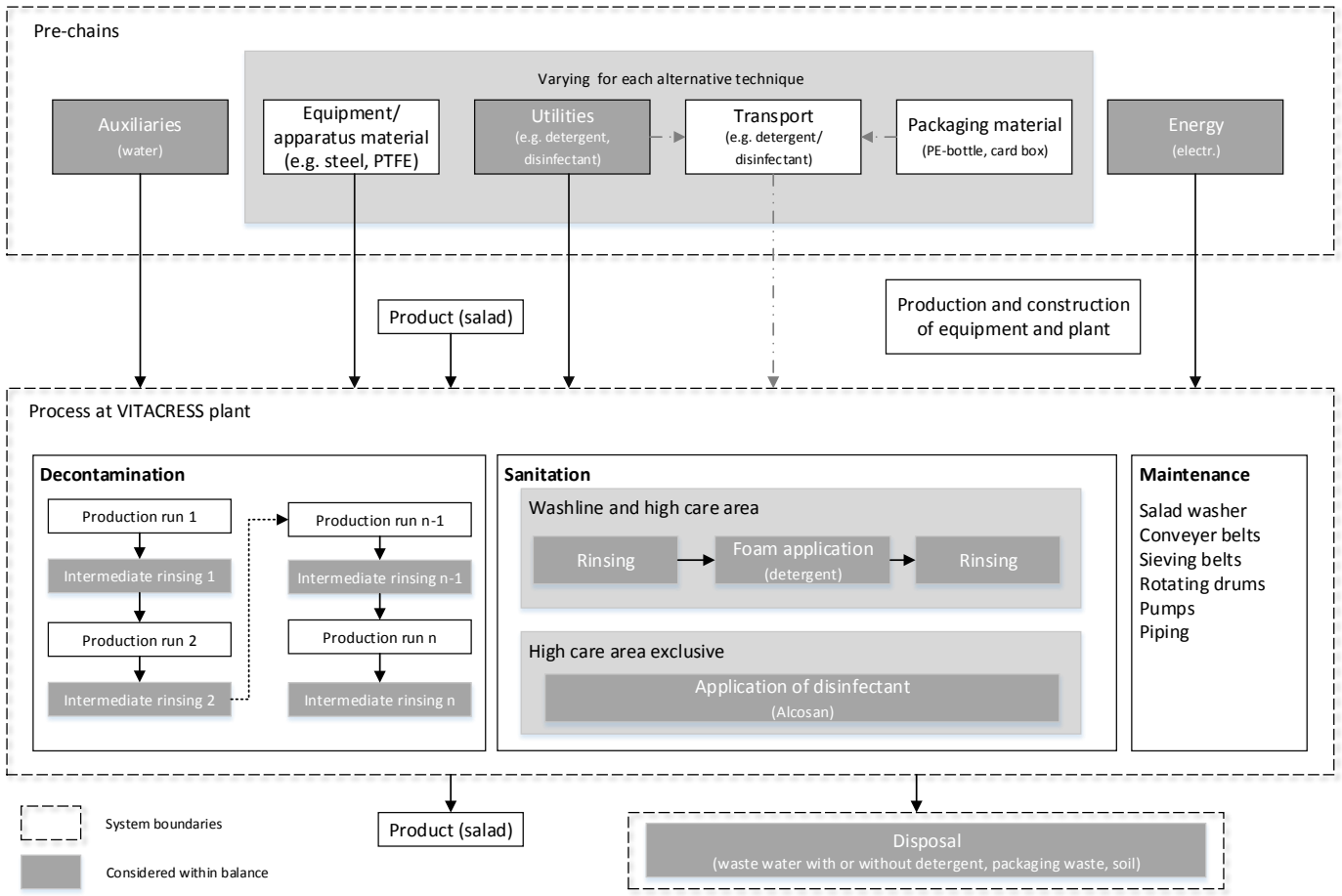

Figure3: Boundaries for sanitation system

Key result n°11: Environmental assessment of the reuse of water at washing step after a O_3/UV treatment

Workpackage: WP5 - Environmental assessment and best practices integration

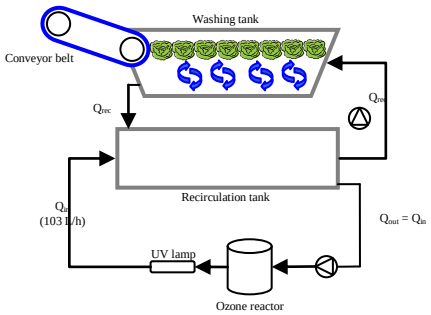

Figure 4: Pilot plant: washing step with a loop to treat a stream of washing water with O_3/UV

Table 1. LCIA results for reference decontamination technique and O3/UV reuse water

Impact category	**Reference**	**O_3/UV**	**Reduction**
Abiotic Depletion (ADP elements) [kg Sb-Equiv.]	1.0E-08	1.0E-08	3.1%
Acidification Potential (AP) [kg SO2-Equiv.]	2.4E-04	2.4E-04	2.7%
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	1.9E-05	1.8E-05	2.5%
Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]	4.7E-02	4.6E-02	2.5%
Ozone Layer Depletion Potential (ODP, steady state) [kg R11-Equiv.]	1.2E-10	1.2E-10	0.8%
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	2.1E-05	2.1E-05	2.7%

Potential impacts

Table 2. Project scientific results

Project scientific results	Impacts	Intermediary steps carried out
Mechanisms of microbial colonisation and biofilm development on MPV and equipment	Comprehensive and detailed understanding of biofilm colonization on biotic and abiotic surfaces in a range of environmental conditions	Visualisation techniques development aiming at dynamics characterization; - High throughput confocal laser microscopy (HTCLM) - Scanning Electron Microscopy - Epifluorescence Microscopy - Flow cells aiming at the visualisation of the kinetics Modelling for : - Biofilm growth - Product contamination development during shelf life
Quantification of the level of pathogen and spoilage bacterial resistance to sanitizing procedures and the ability for re-growth after sanitizing	Comprehensive understanding of resistance mechanisms of pathogens and spoilage organisms in multispecies biofilms	Gathering all genetic, physiological studies and mechanical biofilm resistance (changes in adhesion/cohesion) and with the help of visualization techniques as the High throughput confocal laser microscopy ; modeling
Determination of the level of cross-resistance to stress and pathogenic potential of (pathogenic) microorganisms induced by different sanitation/decontamination approaches	Understanding of the induction of cross-resistance and altered pathogenicity induced by stress conditions induced by the fresh-cut produce processing chains	Project data, modelling
Role played by equipment' geometry and materials – at the macro, micro, and nanometric scales – on microbial contamination patterns and persistence	Interaction dynamics between bio-contaminants and surfaces	Development of *in silico* (Computational Fluid dynamics (CFD) tools development) and *in situ* techniques (data from laboratory scale and pilot-plant scale experiments), modelling (CFD, biofilm growth kinetics)
Predictive models to consider the impact of microbial colonisation of food processing surfaces on MPV colonisation, in conjunction with applied sanitation and decontamination treatments	Data base on pathogenic bacteria development after being treated under various environmental conditions taking into account MPV involved and decontamination conditions	Data acquisition

Diagnostic tools to detect pathogenic microorganisms in a time relevant to positive release of product.	Development of rapid laboratory assessment tools (real-time target)	Technique development as nanotechnology-based molecular diagnostics for 3D on chip amplification systems. PCR and RT-PCR to detect microorganism and resistant and virulence markers.

Table 3. Project technological results

Project technological results	Impacts	Intermediary steps carried out
Information on the critical areas affecting microbial cross-contamination to product	Decision making tool for equipment manufacturers	Demonstration of the links between hygiene dynamics and equipment / processing line design, Hygienic design guidelines
Recommendations for hygienic design of MPV processing equipment integrating advances in surface topography and equipment geometry.		
Environmentally friendly sanitizing procedures.	Mild and efficient sanitizing procedures integrated in LE and SMEs' quality management system	Training and education activities towards MPV industries through workshops organized in the different project countries of the partners involved in Susclean. Presentation in the mother tong of the participants leaded to increase the impacts especially towards SMEs.
Enhanced chemical and physical decontamination techniques that reduce environmental impact whilst maintaining product quality and safety	Mild and efficient decontamination procedures integrated in LE and SMEs' quality management system Integrating equipment following the hygienic design principles	The model used as leafy green vegetables could be expanded to other vegetables and to fresh-cut fruit e.g. the provided equipment hygienic design guidelines takes into account cantaloupe processing specificities. Training and education activities towards the related industries already started during the second period of the project.
Optimisation of current chlorine decontamination processes minimising the use of water and chlorine.	New decontamination processes widely accepted by end-users whatever the company size	Training and education activities
Devices for rapid on-site detection and quantification of cultivable and non-cultivable microorganisms	Availability of real-time monitoring ready to be installed in processing lines to monitor hygiene in the MPV processes	Improvement of the assessment tools to obtain real-time assessment test kits.
Assessment of the environmental impact of existing and improved sanitation and decontamination treatments along the MPV supply chain	Data base for ecobalance analysis systems	Integration of the whole chain from cradle-to-grave (farm, harvesting, transport to retailers, etc.)

Table 4. Project societal results

Project societal results	Impacts	Intermediary steps carried out
Recommendations of emerging techniques in terms of reducing chlorine emissions in water and decreasing water consumption rates in food industries by up to 50%	Mitigation of the potable water use for MPV processing and reduction of carcinogenic compounds released in the environment	Development of the best available techniques documents. Interaction with European projects working on this topic as Veg-i-trade, Resfood (FP7 cooperative projects) and the COST action BacFoodNet.
Upgraded best available techniques (BAT) documents.	Lowering of the environmental impact of the European MPV industries	Implementation of the revised IPPC directive
Transfer of the developed knowledge to the European MPV industry in general and SMEs in particular.	Growth of the MPV European industry providing healthy food to European consumers	Training activities, technical workshops specifically dedicated to SMEs

Project logo

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