Microdroplet formation in polymers by use of food grade additives

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Scope

- *Thermal insulation is a critical parameter for food packaging & foaming polymers are widely used for the production of thermal insulation food packaging materials.*
- *Expanded polystyrene boxes are currently used as insulator with porosity of almost 98%, low density and acceptable insulating performance → Recently there has been much interest to replace polystyrene material with new degradable materials*

→Aim of this study is the use of food grade additives for the formation of polypropylene (PP) droplets to be used as thermal insulating materials

Materials & Methods

Materials

- PP pellets
- Food additives
- Food ingredients
- Fatty acids

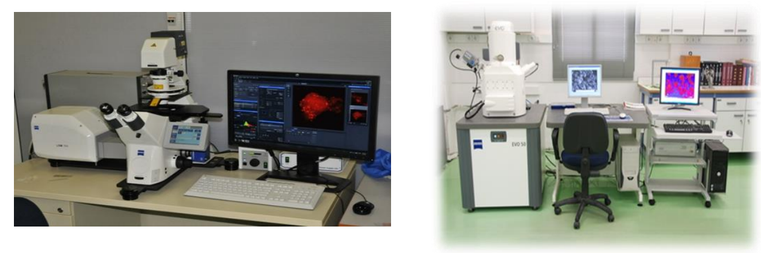
- PP+LDPE+ $NaHCO_3$+stearic acid+ citric acid
- PP + LDPE + $NaHCO_3$ + stearic acid
- PP + NaHCO3 + PEO + stearic acid
- PP + $NaHCO_3$ + PEO + stearic acid + citric acid
- PP + $NaHCO_3$ + stearic acid + PEO + vegetable fat + citric acid
- PP + vegetable fat + $NaHCO_3$ stearic acid + citric acid

Development of PP droplets

- Injection molding in lab & large scale

Materials properties

- Porous structure (SEM, CLSM)



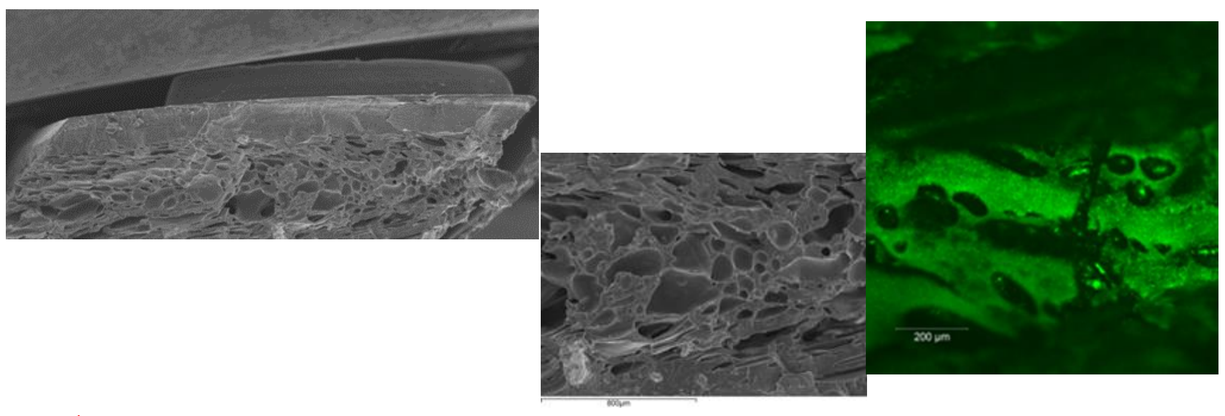
- Surface properties

- Heat Transfer

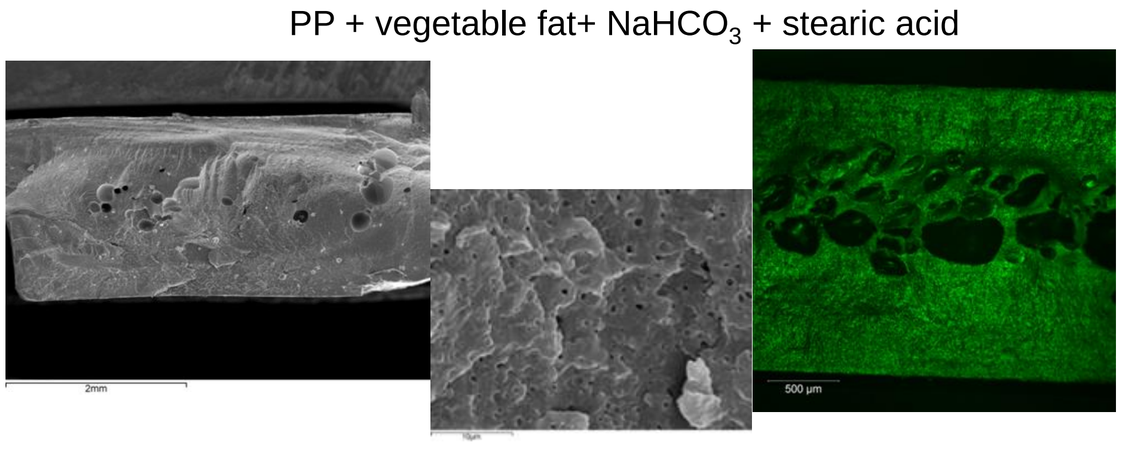
Results & Disscusion

PP Droplets - Porous structure: Lab scale – Injection Molding

PP +$NaHCO_3$ + Stearic acid+ Citric acid



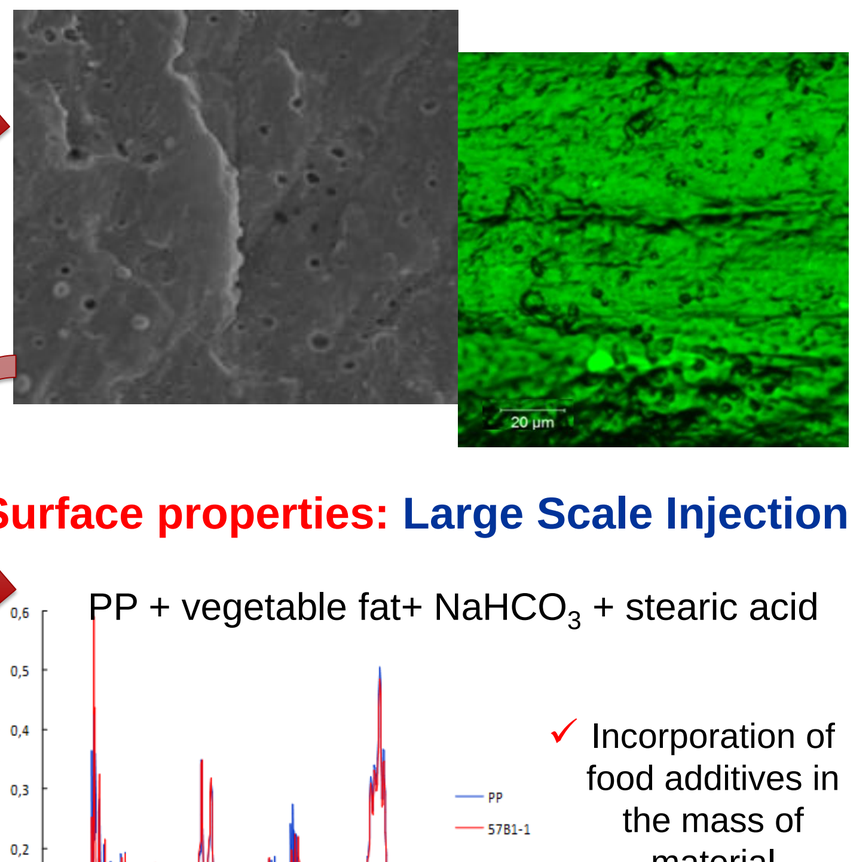
PP + vegetable fat+ $NaHCO_3$ + stearic acid



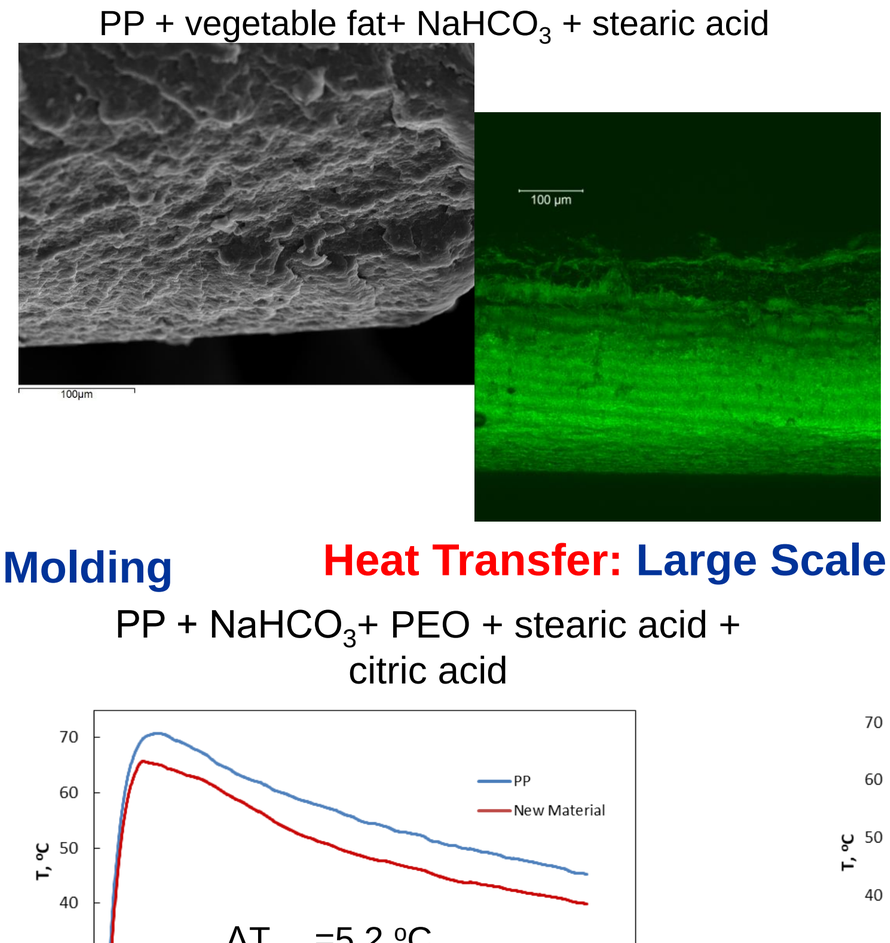
- ✓ Using food additives & ingredients in combination with PP pellets materials that have bubbles of sufficient size and uniform distribution could be produced
- ✓ It is possible to produce food packaging materials containing gas bubbles whose size & distribution depend on the composition of materials selected and the production conditions

PP Droplets - Porous structure: Large Scale Injection Molding

PP +$NaHCO_3$ + Stearic acid+ citric acid



PP + vegetable fat+ $NaHCO_3$ + stearic acid



- ✓ Large scale production induce to the formation of smaller bubbles & lower void fraction

Surface properties: Large Scale Injection Molding

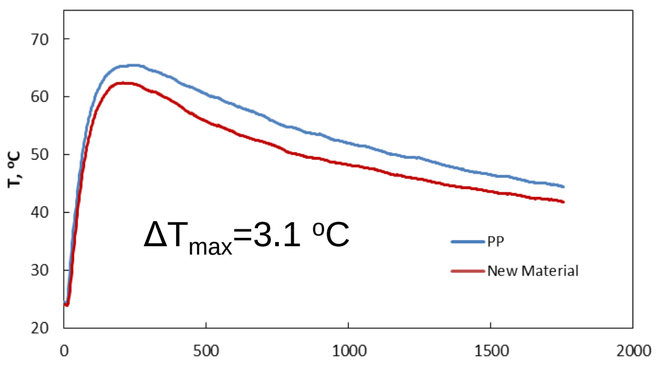
PP + vegetable fat+ $NaHCO_3$ + stearic acid

- ✓ Incorporation of food additives in the mass of material
- ✓ Non-differentiation of the contact angle values (PP= 103,9º, New Material=104,5º)

Heat Transfer: Large Scale Injection Molding

PP + $NaHCO_3$+ PEO + stearic acid + citric acid

PP + $NaHCO_3$ + stearic acid



- ✓ The combination of food additives & food ingredients could be affect the heat transfer rate
- ✓ Optimization materials composition & process condition are needed for further increase of ΔT

Conclusions

- *The type of food additive and their combination affects the properties of the droplets improve the porous structure and the thermal insulating properties of the produced PP based materials in comparison with commercial available PP materials*
- *The produced materials could be used as a possible alternative to polystyrene foam for food packaging*

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