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Research area: Product aims

Paper, paperboard and board/ Packaging papers and paperboard

Key words:

Food packaging, barrier for mineral oil, starch coating

TITLE:

Development of barrier concepts for recycled paper against mineral oil based on starch coatings

Background/Problem area

The papermaking industry is confronted with seriously mineral oil problems. Recycled paper for food packaging contains traces of mineral oil which can diffuse in undesirably large amounts into the packaged food. The primary source of the mineral oil is the printing ink. Generally speaking, there are three options for solving this problem. Firstly, elimination of the source by using fresh fibres or using printing ink without mineral oil. This is a very problematic approach, because the inks do not only have to be forbidden in Germany but even all over the world. A more expensive way is to clean recycled fibres. An enormous amount of research is going on in this field but there is still a need for improvements to achieve satisfactory results. At this point, the most efficient and feasible option is a migration barrier for mineral oil between the packaging paper and the food. At the beginning, PET bags were proposed between board and food to obstruct mineral oil migration. In addition, some synthetic polymers with good barrier properties have already been found such as PA, PLA, PLMA and PVOH. It was observed in preliminary studies that starch and modified starch coatings also show a good barrier effect for mineral oil. The properties of starch and modified starch used for barrier coatings are investigated further in the scope of this project.

Objectives/Research results

The objective of this project is to develop an efficient and economic mineral oil barrier based on starch or modified starch coatings for paper food packaging. As first step native starches with different amylose/amylopectin ratios and modified starches with different modifications and degree of degradation were tested according to their barrier properties against mineral oil. In general, it was found that starch or modified starch coatings are very brittle. Different plasticizers were added to improve film flexibility and reduce embrittlement. Glycerol, urea and polyvinylalcohol were found as good plasitzicer for starch coatings. The most effective plasticizer combination for modified starches and native starches was a combination of glycerol and polyvinylalcohol.

In the next step pigments (calcium carbonate and kaoline) were added to decrease the costs of the barrier coating while obtaining the barrier effect against mineral oil. The effectivity depends on the different starches, but it is possible to decrease the costs of the barrier coating with pigments by obtaining more or less the same barrier effectivity.

It was found that the hold out of the testliner and carton board for the starch coating is too low and this was improved by developing a pigment based precoating. The combination of precoating weight and barrier coating weight with the best barrier properties was evaluated.

In trials it was shown that these starch formulations can be applied with a lab curtain coater on cardboard and on testliner. In experiments performed on the pilot coater "Vestra", it was shown, that coating on industrial level is possible with these precoatings and starch based formulations. Also the limits stated by the third draft of the BMEL Mineral Oil Regulation dated on 24th July 2014 for the accepted amount of migrated mineral oil can be fullfiled. It was demonstrated, that there is no difference in using a bend blade or a curtain coater as coating aggregat. It was also shown that these coatings are recyclable. The breaking of the coating during the folding or creasing process cannot be reduced completely.

Application/Economic benefits

A very important advantage of biopolymer coatings compared to synthetic polymer coatings is the low costs involved. They can cut the price of starch coatings more or less by half compared to the commercial synthetic polymer coatings. Furthermore, most of the modified starch or starch coatings are compatible for use in food packaging. Therefore, this study aims at introducing new possible starch applications, preferably in SMEs in the packaging and paper industry. This type of coating shows little or no water vapour barrier which is also very important because some foods require a steady moisture exchange with the environment. Further, starch is a biopolymer and as such is biodegradable. This is a very important advantage for environmental issues. In addition, starch is already being used in the papermaking industry and presents no recyclability problems. The research on this topic is not only useful for the paper industry and food packaging industry. It can also be transferred as an application to other industrial fields, e.g. mechanical engineering for lubricant coatings and fuel tanks and in the chemical industry for the transport of mineral oil products. Another application would be the environmental engineering for oil barriers or protection from mineral oil exhalation.

Period of time: 01.02.2013 – 30.04.2015

Remarks

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