Bioethanol from corn stover – a review and technical assessment of alternative biotechnologies

Reviewing the literature from the last decade regarding the bioconversion of corn stover into ethanol, 474 references were identified containing 561 datasets. We found 144 datasets which were sufficiently consistent and detailed to address the current state of the art of corn stover conversion to bioethanol, and we were able to categorise 93% of these datasets into eight different technological configurations for the production of bioethanol, based on the pretreatment approaches used. After pretreating, the corn stover is subject to hydrolysis and fermentation, but these two process steps were largely identical in all datasets, albeit a range of operating conditions was reported. The final distillation of the ethanol was very rarely included in the datasets. By parameterising the bioethanol production by 26 parameters, including corn stover compositions, solid loadings, operational conditions, conversion efficiencies and material consumption, we were able to quantify the material flows for each technological configuration and estimate the uncertainty of the flows. The eight technological configurations produced 11–22% ethanol from the dry solid content of the corn stover. Technologies using alkaline-, solvent or ammonia-based pretreatments produced the largest amount of ethanol (19–22%), while fungi-based pretreatment produced much less (11%). All technological configurations resulted in large flows of solid as well as liquid residues, typically containing 60 to 70% of the dry solid corn stover content. Based on the selected datasets, statistical description is provided for all parameters, including mode, median, average and deviation, within each technological configuration. Bivariate correlation analysis across and within all technological configurations indicates that some operational parameters usually considered crucial in laboratory studies, e.g. pretreatment severity, show from a statistical perspective very little correlation with the yields. The review reveals that a great deal of research has addressed the challenge of converting corn stover into bioethanol, but a significant part of these studies is of limited value in terms of scope and documentation when addressing overall material flows and key parameters in a technological context.

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