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# Effects of new fixative additives on leachability of boron wood preservatives

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## INTRODUCTION

- Several products are used currently:

- boric acid ( $H_3BO_3$ ),
- sodium tetraborate décahydrate ( $Na_2B_4O_7 \cdot 10H_2O$ ),
- disodium octaborate tetrahydrate ( $Na_2B_8O_{13} \cdot 4H_2O$ )

- Advantages and drawbacks of borate treatments

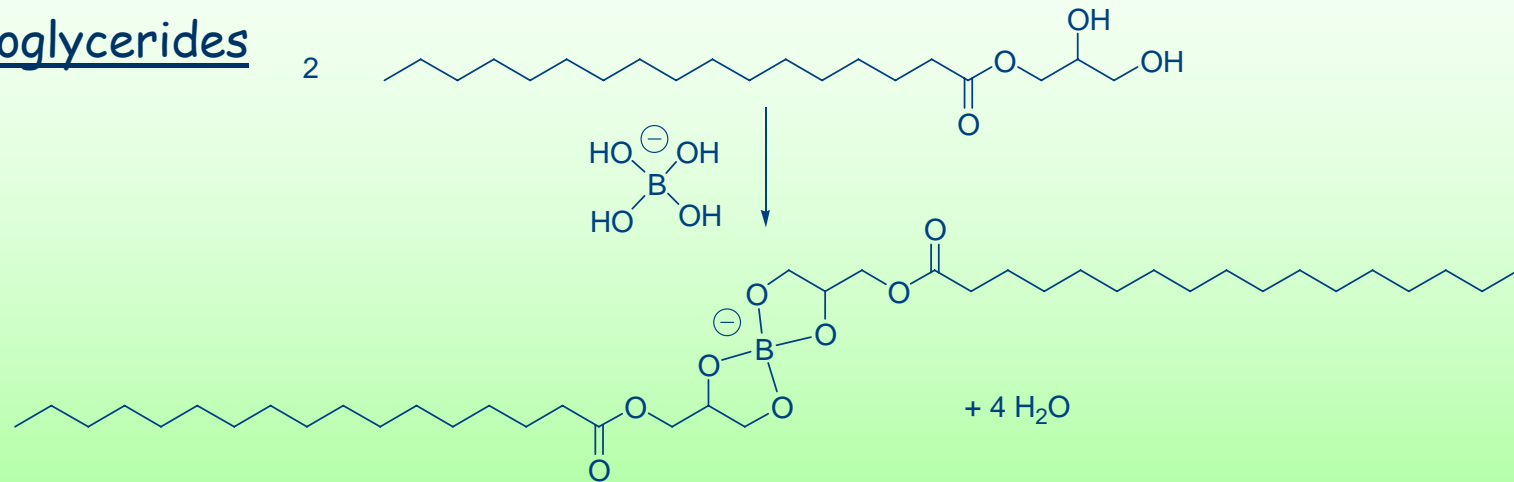
- Effective against fungi and insects
- Low cost
- Soluble in water
- Incolore and low vapor pressure
- Low environmental impact and low mamalian toxicity
- Leachability
- Classified as toxic for reproduction in Europe

- Improvement of their fixation represents therefore a crucial point for their development in the future

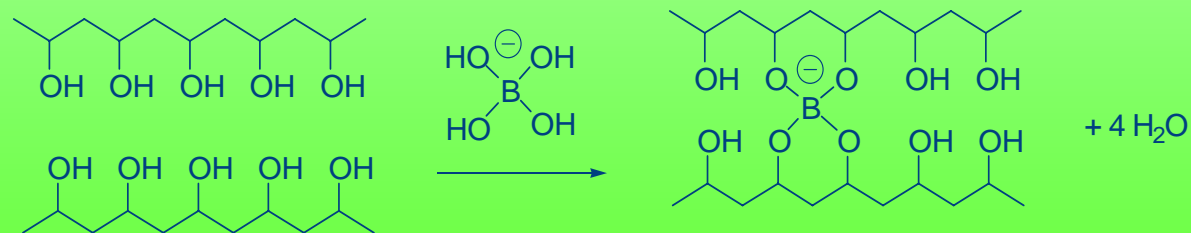
# Aims of the study

Evaluate new additives to improve boron fixation and wood's durability

## ➤ Monoglycerides



## ➤ Polyvinyl alcohol



## MATERIALS AND METHODS

### ➤ Material

Scots pine sapwood and European beech samples (10 x 15 x 50 mm)

### ➤ Impregnation procedure

Double impregnation process using a vacuum of 5 mbar for 30 min. for each impregnation: DOT was impregnated in a first time followed by additive impregnation in a second time.

- ✓ DOT tested at 3 concentrations (1, 2 and 4% Boric Acid Equivalent (BAE))

- ✓ Additives tested at 2 concentrations

  - 10 or 15 % of Monoglycerides mixture (Novance, France)

  - 2.5 or 4% of Polyvinyl alcohol, Elvanol® 90-50 (DuPont, France)

### ➤ Leaching procedure

Boron leachability was carried out according to ENV 1250-2 standard

### ➤ Boron determination

- Boron analysis was performed with a Varian SpectrAA 220 FS atomic absorption spectrometer using standard solutions comprised between 100 and 1000 mgL<sup>-1</sup>

- Boron retention was estimated by difference between the quantity of boron present in wood after the first impregnation and quantity of boron measured in cumulate leachates

### ➤ Biological tests

Decay resistance was evaluated with *Poria placenta* after 16 weeks according to a procedure adapted from EN-113 standard

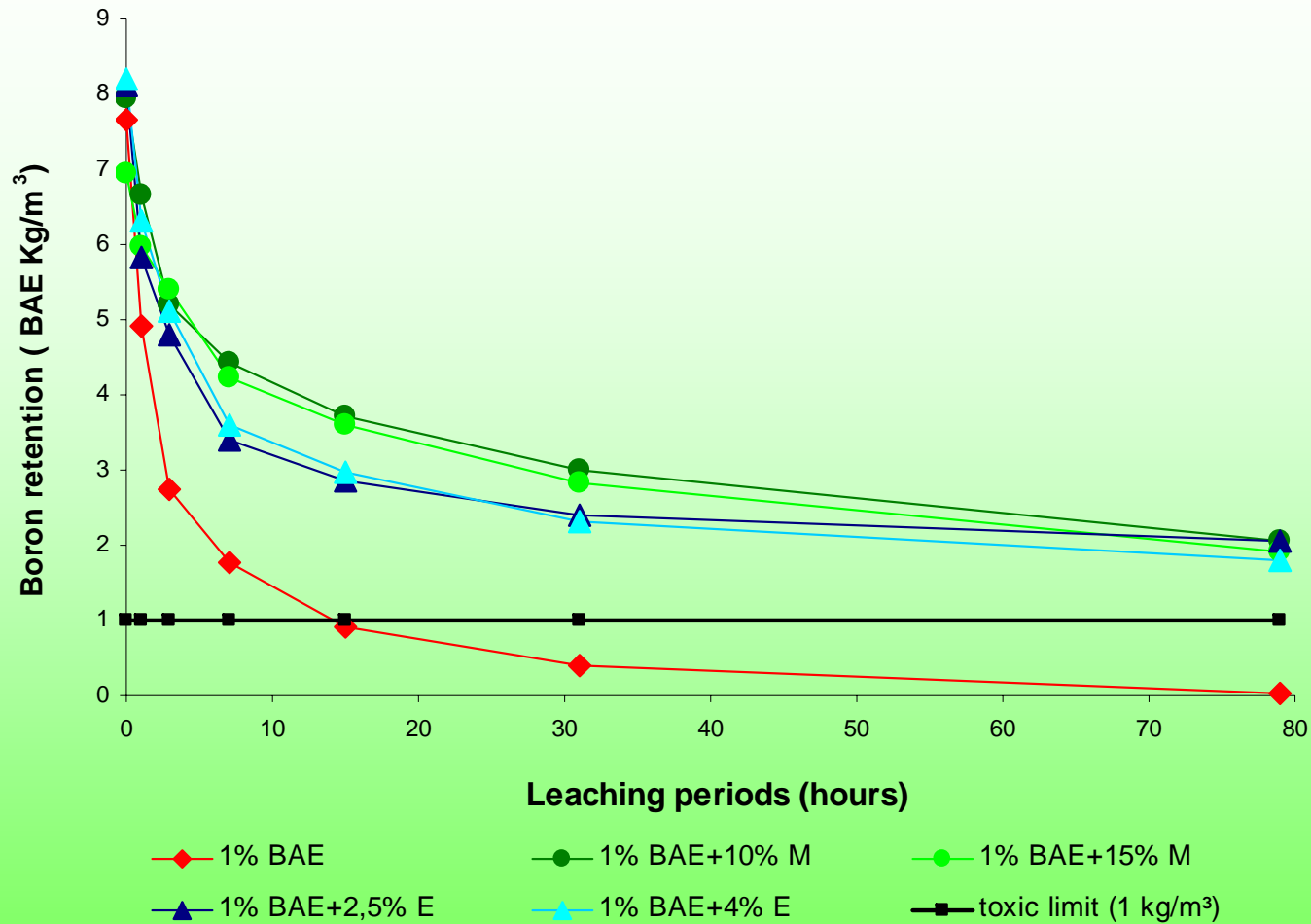
# RESULTS

Boron retention of Scots pine sapwood samples treated with DOT followed by a second treatment with different additives

| Treatment        | Initial retention<br>BAE kg/m <sup>3</sup> | BAE(kg/m <sup>3</sup> ) retained after different periods of leaching |         |         |          |          |          | % BAE retained |
|------------------|--|--|---------|---------|----------|----------|----------|----------------|
|                  |  | 1 hour   | 3 hours | 7 hours | 15 hours | 31 hours | 79 hours |                |
| 1% BAE           | 7.65                                       | 4.92   | 2.73    | 1.76    | 0.91     | 0.41     | 0.04     | 0.52           |
| 1% BAE + M- low  | 7.95                                       | 6.65   | 5.20    | 4.44    | 3.71     | 3.00     | 2.07     | 26.04          |
| 1% BAE + M- high | 6.95                                       | 5.96   | 5.40    | 4.23    | 3.59     | 2.82     | 1.92     | 27.63          |
| 1% BAE + E- low  | 8.12                                       | 5.83   | 4.79    | 3.41    | 2.87     | 2.40     | 2.05     | 25.25          |
| 1% BAE + E- high | 8.19                                       | 6.31   | 5.11    | 3.61    | 2.97     | 2.32     | 1.80     | 21.98          |
| 2% BAE           | 16.98                                      | 10.23  | 4.98    | 3.00    | 1.51     | 0.65     | 0.04     | 0.24           |
| 2% BAE + M- low  | 16.10                                      | 13.79  | 10.82   | 9.46    | 8.22     | 6.88     | 4.86     | 30.19          |
| 2% BAE + M- high | 15.20                                      | 13.28  | 12.06   | 9.65    | 8.30     | 6.66     | 4.77     | 31.38          |
| 2% BAE + E- low  | 16.95                                      | 12.77  | 10.81   | 7.77    | 6.55     | 5.40     | 4.62     | 27.26          |
| 2% BAE + E- high | 16.20                                      | 13.29  | 11.49   | 8.70    | 7.44     | 6.13     | 5.11     | 31.54          |
| 4% BAE           | 32.52                                      | 19.01  | 8.67    | 4.72    | 2.26     | 1.01     | 0.18     | 0.55           |
| 4% BAE + M- low  | 29.95                                      | 24.67  | 17.45   | 13.79   | 10.74    | 8.36     | 6.03     | 20.13          |
| 4% BAE + M- high | 29.90                                      | 23.95  | 20.36   | 13.98   | 11.24    | 8.40     | 6.16     | 20.60          |
| 4% BAE + E- low  | 32.15                                      | 23.71  | 19.41   | 12.89   | 10.49    | 8.61     | 7.61     | 23.67          |
| 4% BAE + E- high | 32.18                                      | 25.73  | 21.80   | 16.83   | 13.70    | 11.08    | 9.61     | 29.86          |

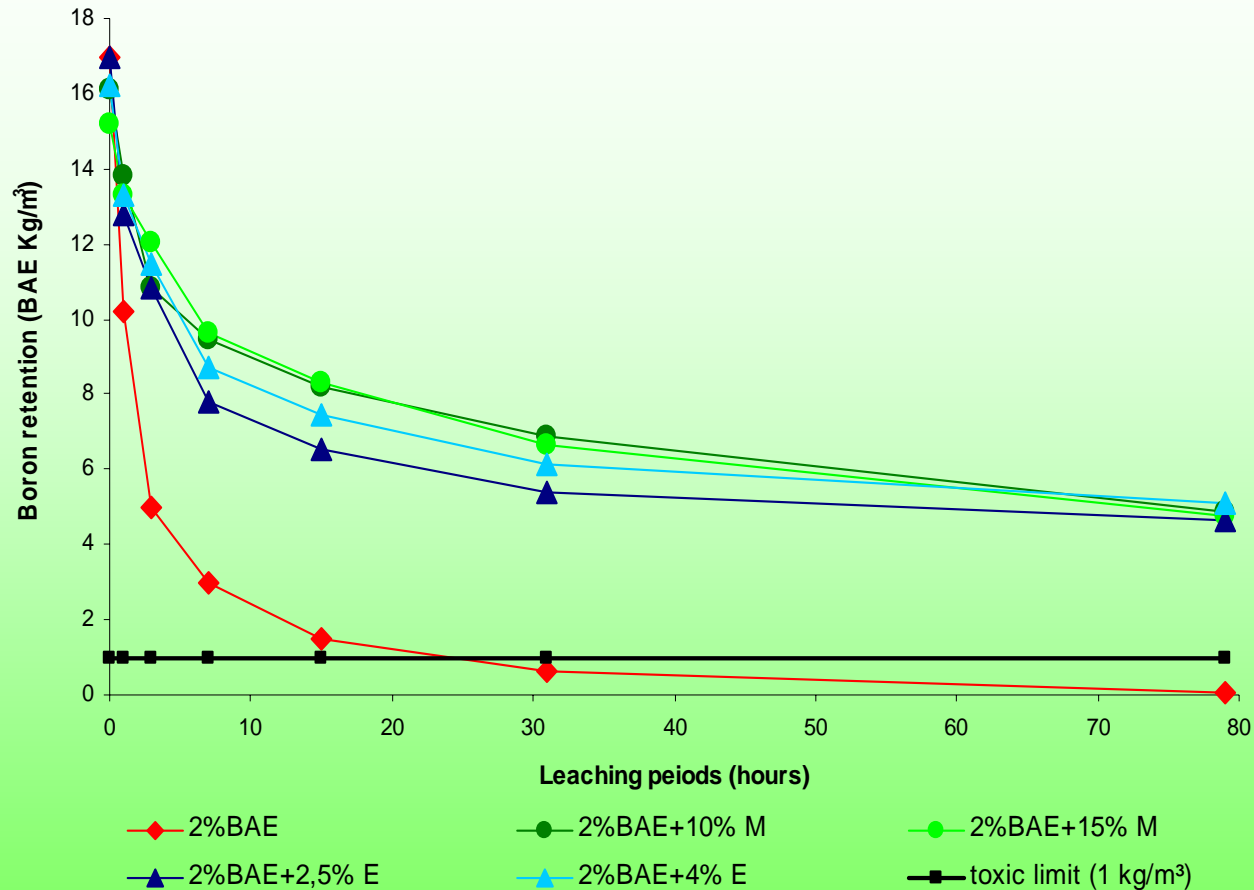
Similar results were obtained with beech samples

## Boron retention of Scots pine sapwood DOT treated at 1% BAE with and without monoglycerides or polyvinyl alcohol after leaching



Estimated boron retentions in wood with additives are slightly above the toxic limit of 1kg/m<sup>3</sup> reported in the literature

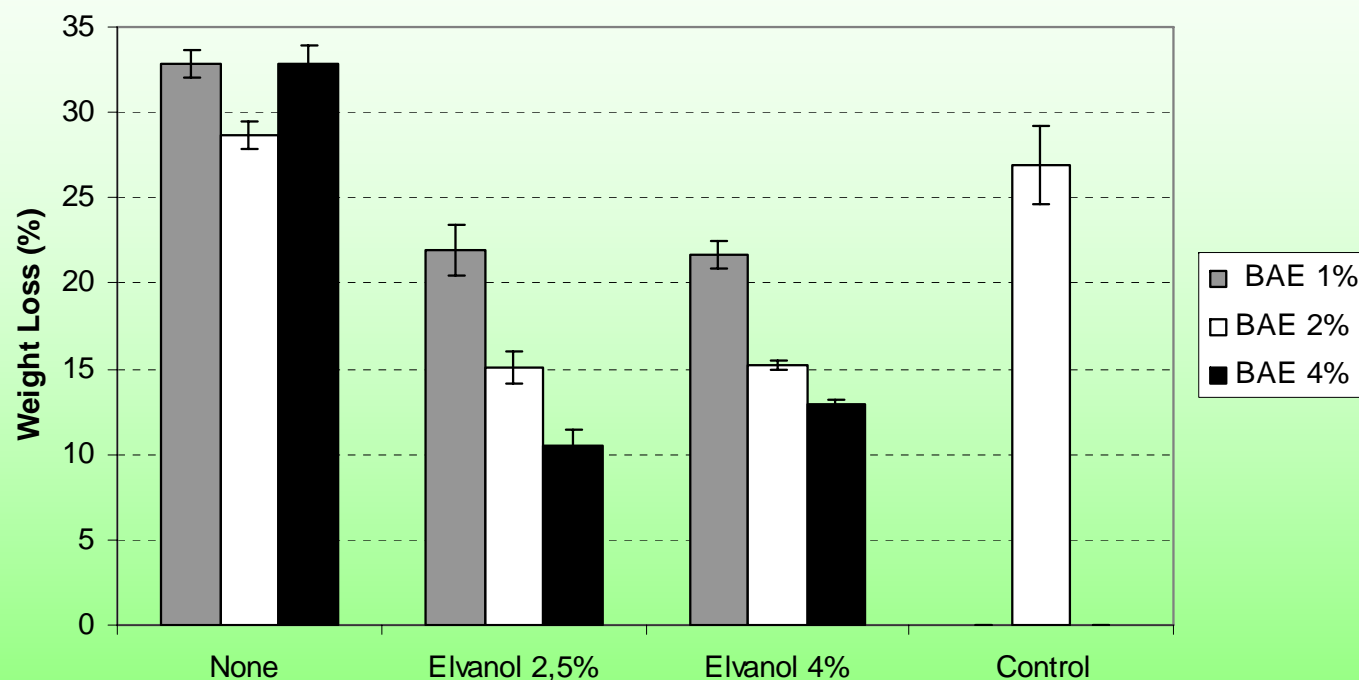
## Boron retention of Scots pine sapwood DOT treated at 2% BAE with and without monoglycerides or polyvinyl alcohol after leaching



Estimated boron retentions in wood with additives are largely above the toxic limit  
Similar results were obtained at 4% BAE and with beech



## Effects additives on wood durability



Weight losses after 16 weeks exposure to *Poria placenta* of pine blocks treated with different boron concentrations and PVA after leaching

## Conclusion and perspectives

- Monoglycerides like polyvinyl alcohol allow to reduce boron leachability
- Reduction of the mycelium development at the surface of the leached treated blocks during the first part of decay test, which was not observed for longer exposure times
- Efficacy of the treatment is not sufficient to prevent totally fungal degradation as demonstrated by the partial protection obtained
- Biological efficacy of complexed boron ?
- Improvement of treatment performances with the use of higher boron and/or additive concentrations ?
- Applications for intermediate hazard class in which the wood is exposed to low natural leaching conditions

## Acknowledgements

Agence Universitaire de la Francophonie for a Post-doctoral grant for the first author of the study

**Thank you for your attention**