

Treatment of Scots pine wood with oil in water and water in oil emulsion systems: Effects on boron leaching and water absorption

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BACKGROUND & Problem Statement

	BORON		OILS
Environmental friendly	😊		😊
Fungicide and insecticide	😊	↔	😐
Flame retardant	😊	↔	😞
Water repellent	😞	↔	😊

High retention and deep penetration of oil → good long-term performance in outdoor conditions



EMULSIONS

Combination of oil and boron in single treatment ✓

Control of retentions ✓

Aim of the study;

- Possibilities of reducing oil retention
- Water absorption and water repellent efficiency of treated pine wood samples
- Leaching amount of boron from treated wood

MATERIALS



WOOD SAMPLES:

- Scots pine (*Pinus sylvestris* L.) sapwood (15 x 25 x 50 mm)
- The moisture content of samples was around 12%.



OILS:

- Sunflower oil was provided by the Ordu Oil Company-Turkey.
- Used (waste) vegetable oil was provided Ezici waste oil collecting company-Turkey.



SURFACE ACTIVE AGENT:

- Detergent based sodium dodecyl sulphate (SDS), Merck.
- Polymer based Kollicoat (KC), Basf.

CHEMICALS:

- Boric acid (Merck)
- Nitric acid (Merck)
- Hydrogen peroxide(Carlo Erba)



Preparation of the formulations



- W/O and O/W emulsions were prepared with a dispenser and continued to mix with a shaker for 12 hours.

O/W emulsion

- ❖ O/W ratio 1/4 and 2/3 (w/w)
- ❖ Sunflower and used waste oil
- ❖ Sodium dodecyl sulphate (SDS) and Kollicoat (KC)
- ❖ 3%BA solution

W/O emulsion

- ❖ W/O ratio 1/4 and 2/3 (w/w)
- ❖ Used waste oil
- ❖ Kollicoat (KC)
- ❖ 3%BA solution

Impregnation and treatments;



Impregnation with O/W emulsions

- 600mm-Hg vacuum for 30 min and a pressure of 5 bar for 60 min.
- Samples treated with KC wrapped up in an aluminum foil and put in an oven at 80 °C for 24 hours after the impregnation

Impregnation with W/O emulsions

- 600mm-Hg vacuum for 30 min and a pressure of 5 bar for 60 min.
- **3 parallel treatments**
 1. Samples in the first group were wrapped up in an aluminum foil and put in an oven at 80 °C for 24 hours after the impregnation.
 2. Heat applied at 100 °C and 160 °C during the impregnation of other two groups, respectively.

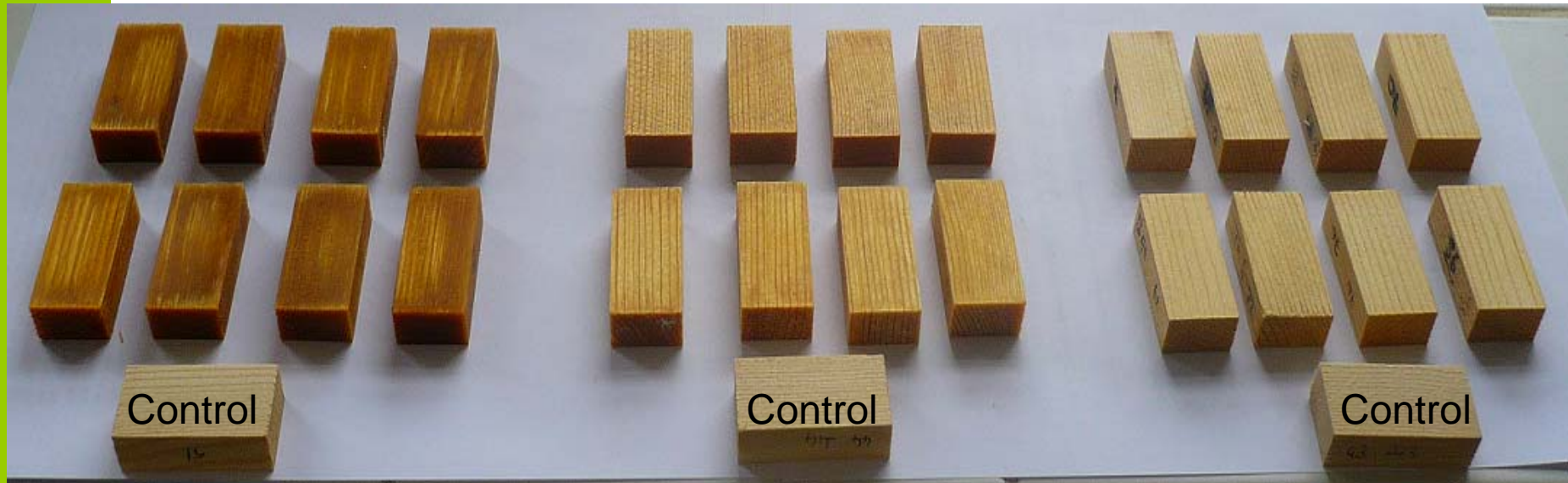
TESTS

- **Absorption** → the weights before and after the impregnation
- **Retention** → the oven dry weights before and after the treatments
- **Water absorption and water repellent efficiency test** → 6, 24, 48h and thereafter at 48-hour intervals, total of 14 days
- **Boron analysis in wood;**
 - Sample preparation** → AWPA A7-93 (1993)
 - Boron analysis of the samples** → Inductively Coupled Plasma Spectrometer (ICP-AES)

Oil treated samples

W/O treated samples

O/W treated samples



RESULTS

Retention and absorption of oils (kg/m³)

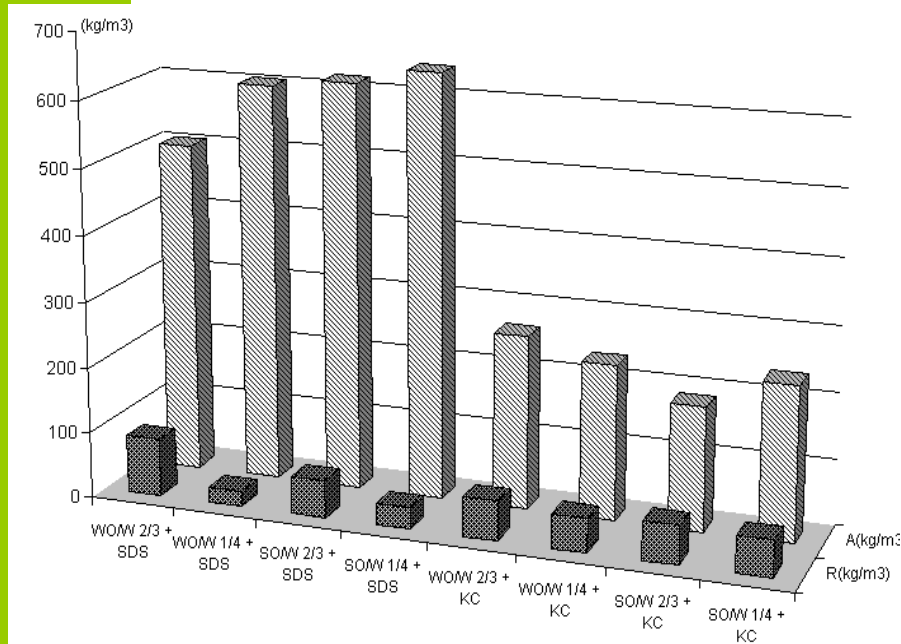


Figure 1. Retention and absorption of oil/water emulsion formulation (kg/m³)

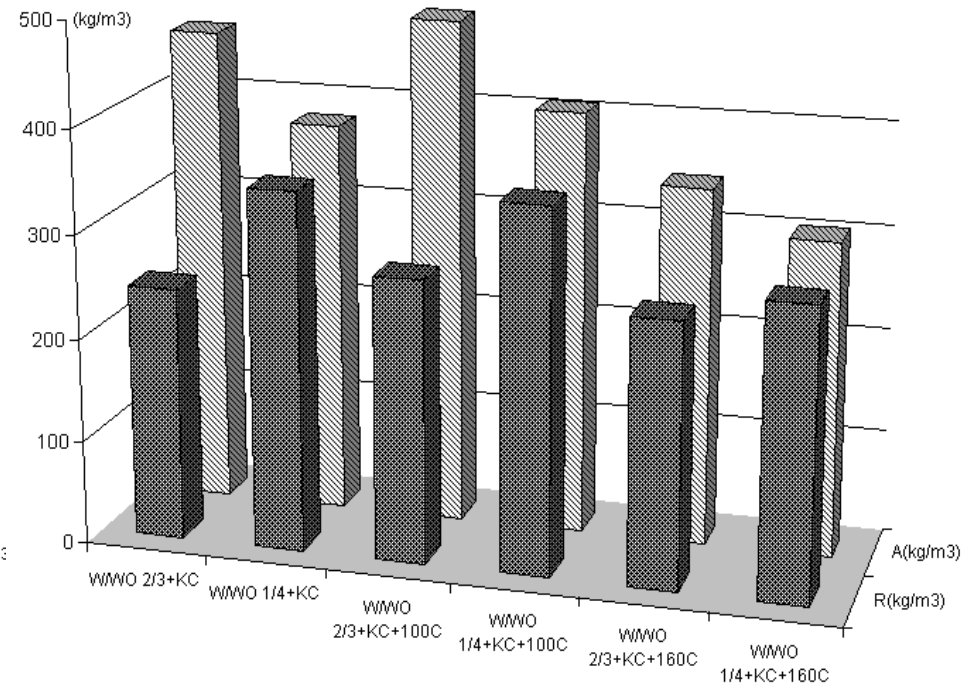


Figure 2. Retention and absorption of water/oil emulsion formulation (kg/m³)

Retention of pure oil ➔ 500-550kg/m³

Water Absorption (%)

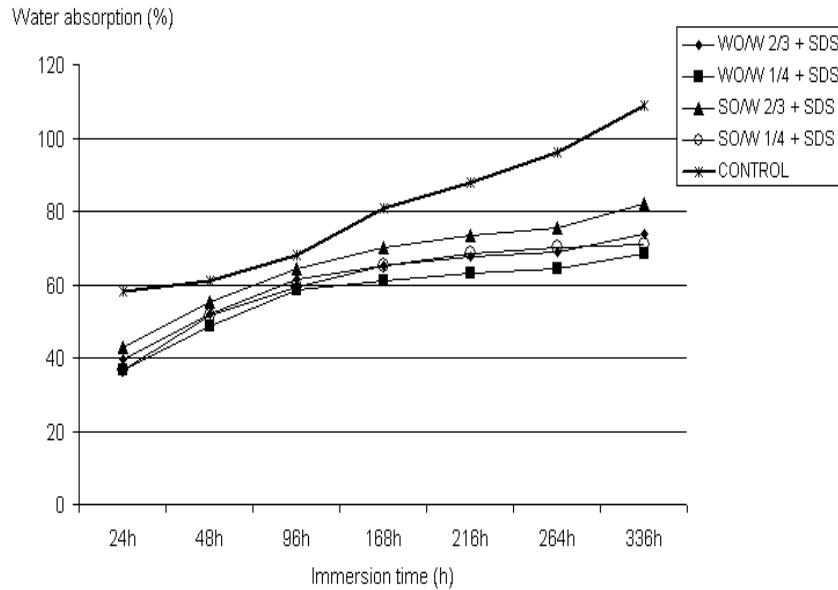


Figure 3. Water absorption of O/W emulsion prepared with SDS and BA

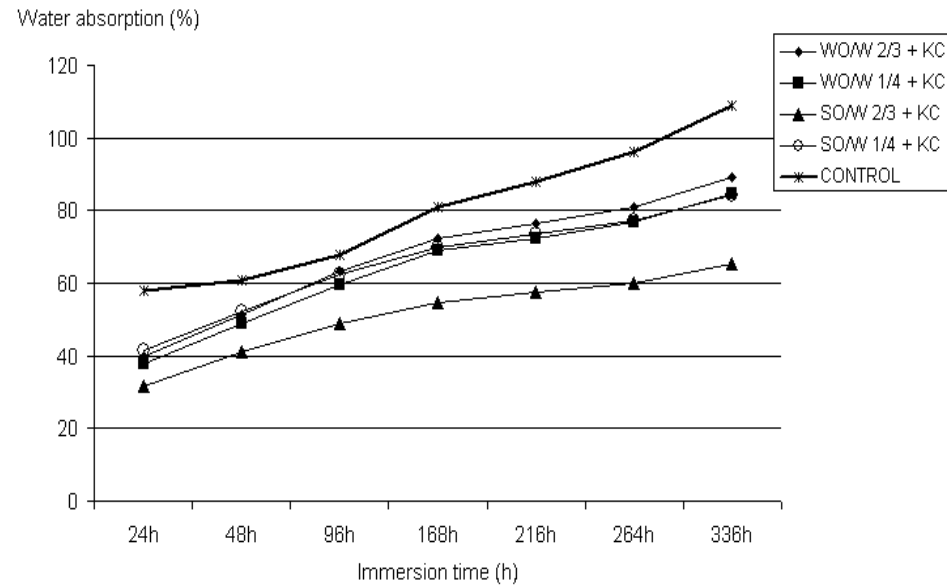


Figure 4. Water absorption of O/W emulsion prepared with KC and BA

Controls → 110%

Boron treated samples → 115%

Waste oil treated samples → 22%

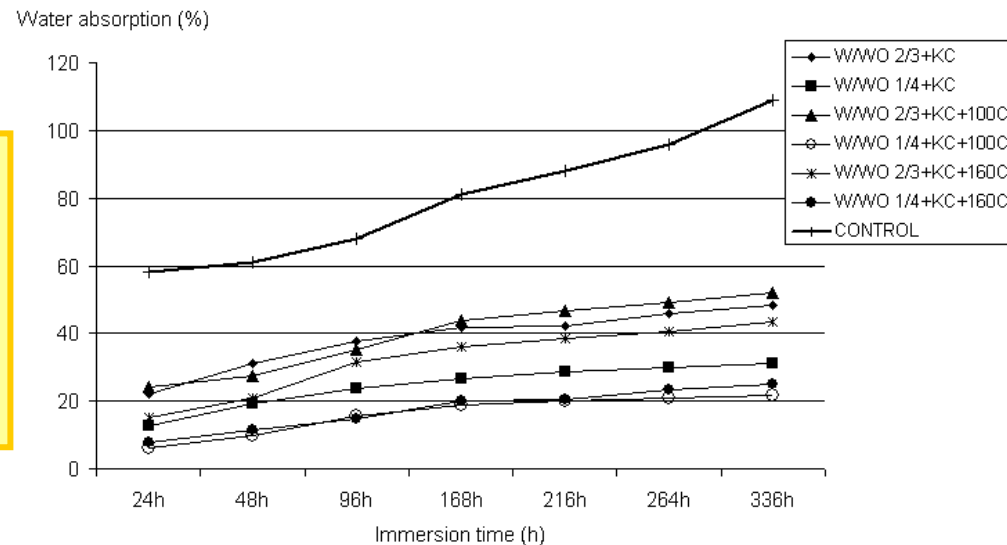


Figure 5. Water absorption of W/O emulsion prepared with KC and BA

Water Repellent Efficiency (%)

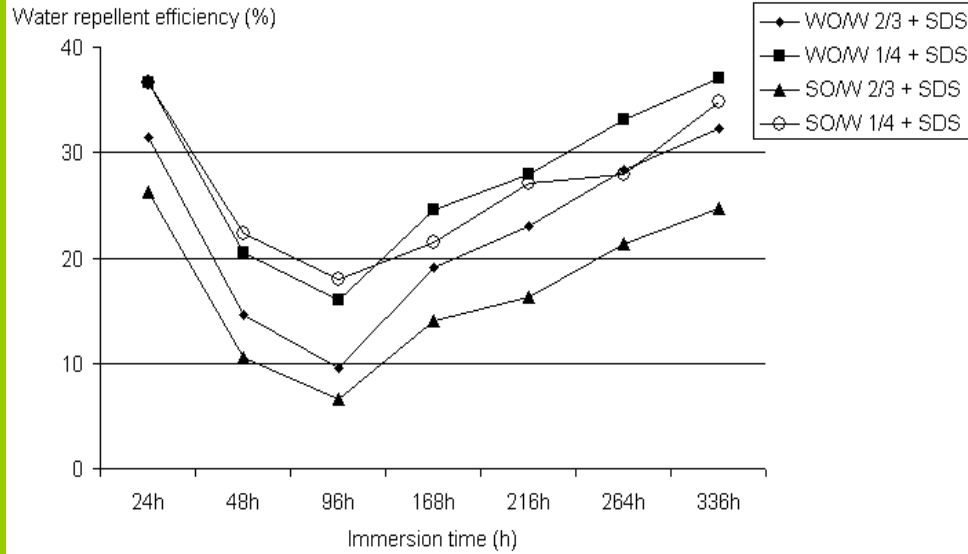


Figure 6. Water repellent efficiency of O/W emulsion prepared with SDS and BA

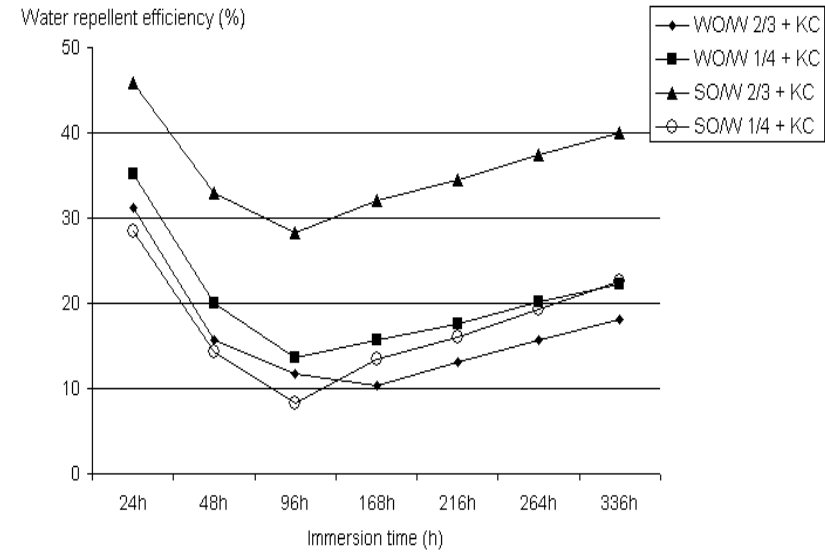


Figure 7. Water repellent efficiency of O/W emulsion prepared with KC and BA

Waste oil treated samples

↓
80%

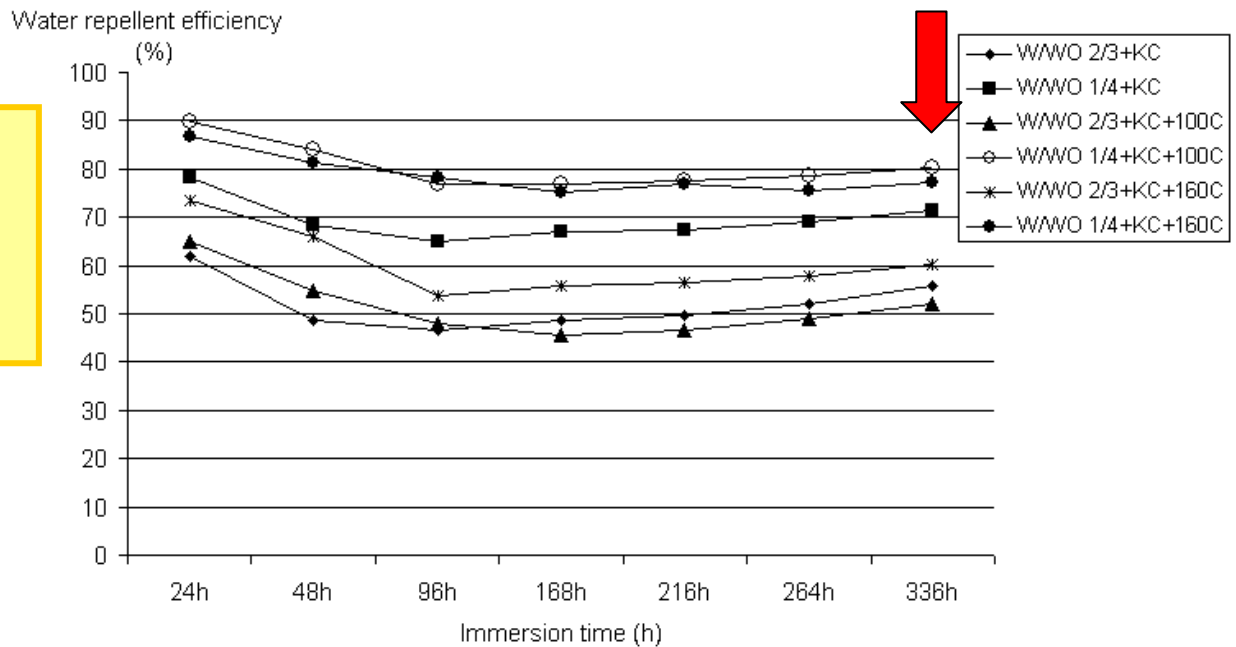


Figure 8. Water repellent efficiency of W/O emulsion prepared with KC and BA

Boron amount inside wood after leaching

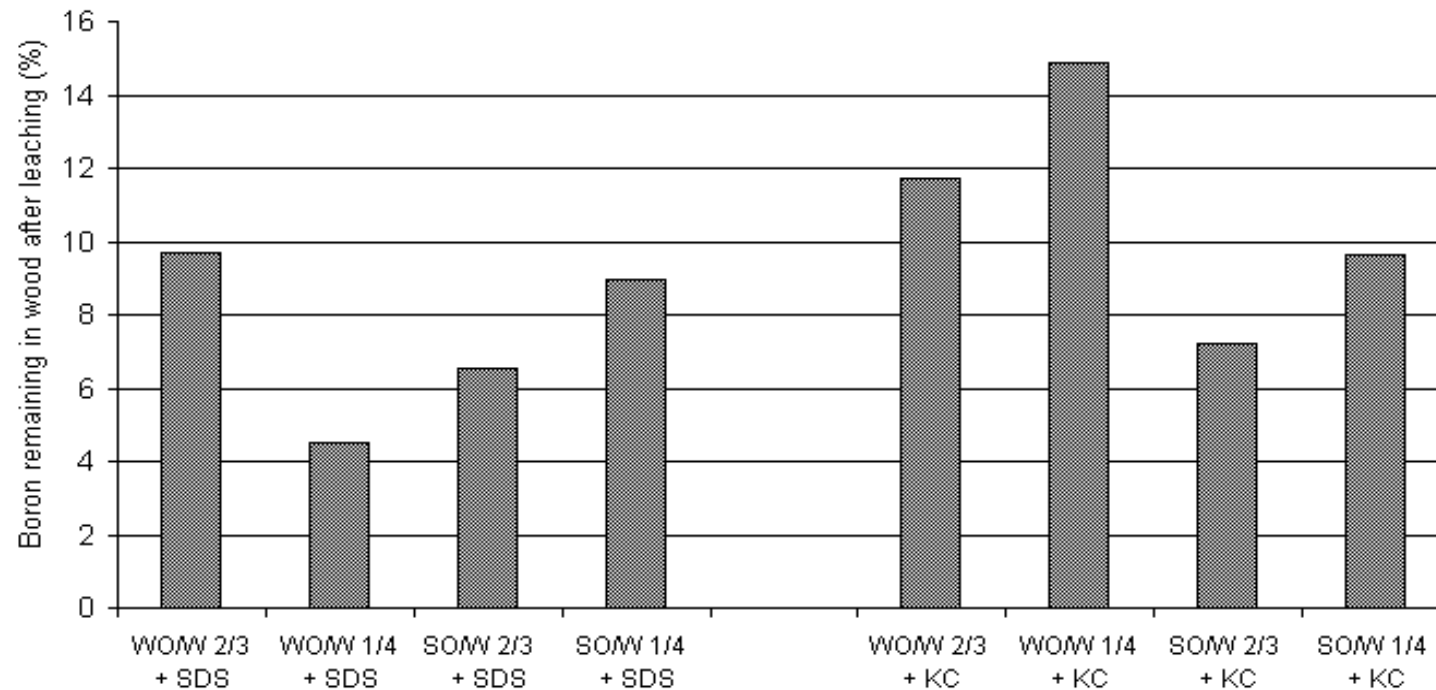


Figure 9. Boron remaining (%) in **O/W emulsion** treated wood samples after leaching 336h in distilled water

Boron amount inside wood after leaching

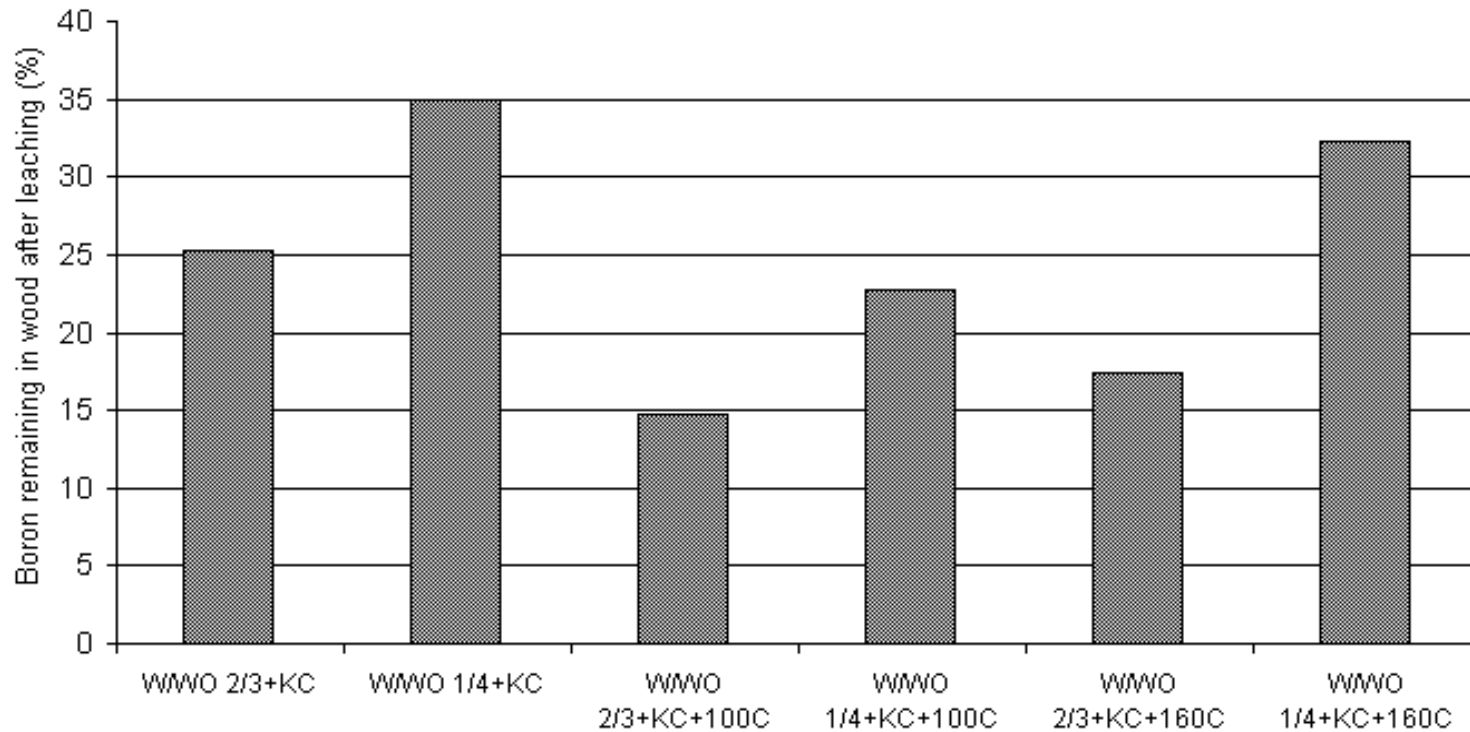


Figure 10. Boron remaining (%) in **W/O emulsion** treated wood samples after leaching 336h in distilled water

CONCLUSIONS

- ✓ Oil retentions could be decreased by using W/O and O/W emulsion formulations.
- ✓ BA can be imparted to the formulation.
- ✓ After impregnation with emulsions, wood surface was not seemed oily.
- ✓ Emulsion treatments reduced the water uptake of pine wood and boron treated wood. With W/O formulation almost equal efficiencies can be reached as with pure oil even if the retentions are considerably lower.
- ✓ Surface active agent had an important role on the performance of the emulsion. Polymer based KC was better than detergent based SDS.
- ✓ W/O formulations seems a potential method of decreasing the amount of oil and combining the boron and oil in one formulation and also keeping the boron inside wood to a level of 35%.

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WEDNESDAY
23 JAN

MINIMIZING