FACULTEIT BIO-INGENIEURSWETENSCHAPPEN

DEVELOPMENT OF AN ANALYTICAL METHOD FOR MULTI-PESTICIDE RESIDUE DETERMINATION IN LNs AND COMPARATIVE EFFECTS OF WASHING AND DRYING PROCEDURES ON 3 LONG-LASTING INSECTICIDAL MOSQUITO NETS

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INTRODUCTION

Long-lasting insecticidal mosquito nets (LNs) are frequently used around the world to protect people against malaria vectors. As they contain insecticide, laboratory control is needed to check whether the content of the active ingredient is according to the manufacturers or WHO specifications and also whether the LN is still efficient after some time of use.

Due to the fact that LNs include a range of polymers for the yarn and use coated or incorporated technologies for the active ingredient, it is a challenge to find a single analytical method to determine the active ingredient in LNs, which takes into account both impregnation technologies.

Since LNs efficacy depends a lot on their use in field conditions, questions rise like what happens with the active ingredient when nets are washed and dried in different ways.

To answer these questions, experiments were carried out to propose a multi-pesticide residue determination in LNs and to investigate the difference between laboratory hand washing simulation using the CIPAC washing agent and domestic washing on different bed nets, as well as the effect of the drying process on the release of active ingredient.

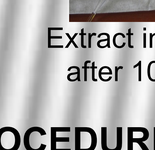
MATERIALS AND METHODS

❑ NETS AND INSECTICIDES

2 Technologies ⟷ **3 Brands**

Coated

Surface of the fiber →
Body of the fiber →

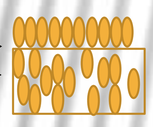


Active ingredient on the net surface

- PermaNet®2.0 (deltamethrin 55 mg/m²)
- Interceptor® (α-cypermethrin 200 mg/m²)

Incorporated

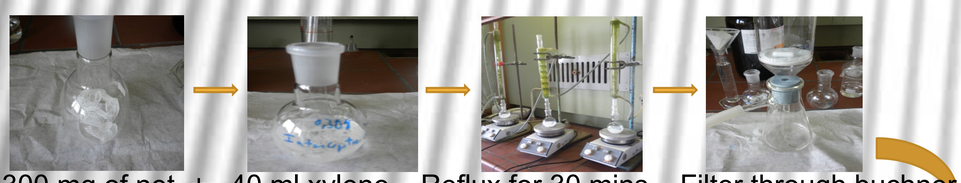
Surface of the fiber →
Body of the fiber →



Active ingredient uniformly incorporated into the fiber and on the surface

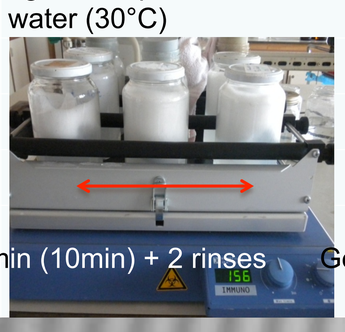
- Netprotect® (deltamethrin 79 mg/m²)

❑ PRINCIPLE OF THE PROPOSED ANALYTICAL METHOD

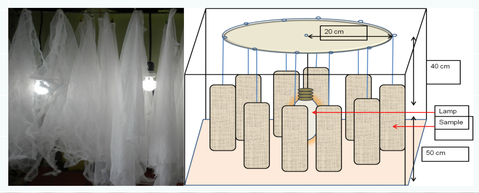


300 mg of net + 40 ml xylene → Reflux for 30 mins → Filter through buchner → Fill up to 50 ml → Extract into GC vial after 10 times dilution → Injection in GC-ECD

❑ WASHING PROCEDURES

	Laboratory hand washing simulation	ISO 6330:2000 (Domestic washing procedure)
Soap	CIPAC washing agent	IEC A* Reference detergent
Washing solution	8g/l of soap in deionized water (30°C)	According to the washing program
Process	 155 beat/ min (10min) + 2 rinses	 Gentle cycle of 30°C - washing program

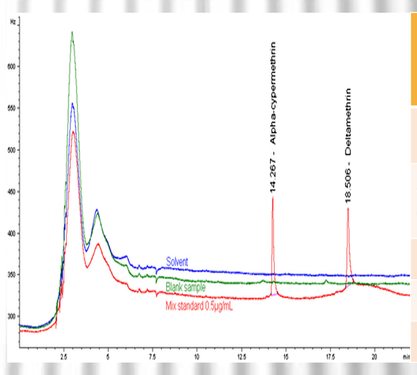
❑ DRYING PROCEDURES

	Indoor drying	Outdoor drying
Real case		
Process	Sample hung without direct sunlight contact	Samples hung for outdoor drying with UV-light [“True-Light” lamp (23 W True-Light E 27)]
Study case		

RESULTS AND DISCUSSION

❑ ANALYTICAL PERFORMANCE

Selectivity/Specificity



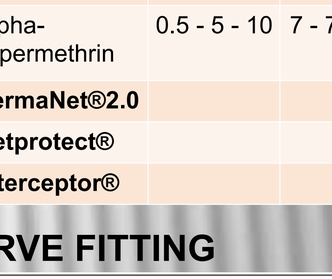
Repeatability / Recovery / Accuracy / LOQ

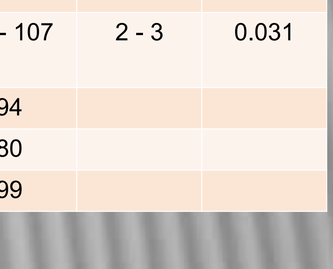
	Spiking levels (g/kg)	N	Mean R (%)	Mean RSD (%)	LOQ g/kg
Deltamethrin	0.2 - 2 - 4	7 - 7 - 6	90 - 108	1 - 3	0.029
Alpha-cypermethrin	0.5 - 5 - 10	7 - 7 - 6	86 - 107	2 - 3	0.031
PermaNet®2.0			94		
Netprotect®			80		
Interceptor®			99		

❑ WASH CYCLES AND CURVE FITTING

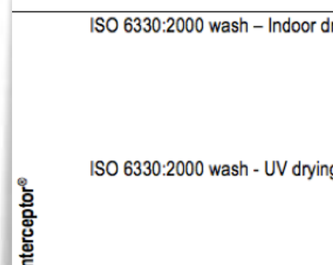
Type of nets	Cycles	Equation[b]	F-test of the model						Model parameters		
			R	R- Square	F	df1	df2	Sig.	Constant (b0)	b1	b2
Interceptor®	ISO 6330:2000 wash – Indoor drying	Linear	0.832	0.692	69.794	1	31	0.000	3.511	- 0.112	
		Logarithmic	0.828	0.685	67.421	1	31	0.000	3.96	- 0.790	
		Quadratic	0.848	0.720	38.509	2	30	0.000	3.836	- 0.203	0.004
		Exponential	**0.864**	**0.746[a]**	91.073	1	30	0.000	3.656	- 0.049	
	ISO 6330:2000 wash - UV drying	Linear	0.760	0.577	42.279	1	31	0.000	3.635	- 0.112	
		Logarithmic	**0.808**	**0.653[a]**	58.455	1	31	0.000	4.197	- 0.841	
		Quadratic	0.793	0.629	25.409	2	30	0.000	4.123	- 0.248	0.006
		Exponential	0.772	0.596	45.822	1	31	0.000	3.719	- 0.046	
	Laboratory standard wash – Indoor drying	Linear	0.914	0.835	157.326	1	31	0.000	3.858	- 0.151	
		Logarithmic	0.854	0.729	83.484	1	31	0.000	4.325	-1.000	
		Quadratic	0.918	0.843	80.322	2	30	0.000	4.063	- 0.209	0.003
		Exponential	**0.939**	**0.881[a]**	229.786	1	31	0.000	4.321	- 0.072	

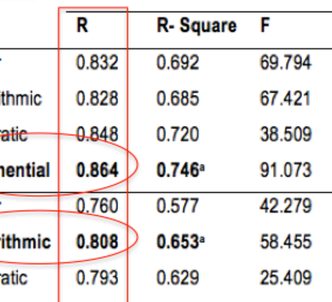
❑ LABORATORY HAND SIMULATION VERSUS ISO 6330:2000

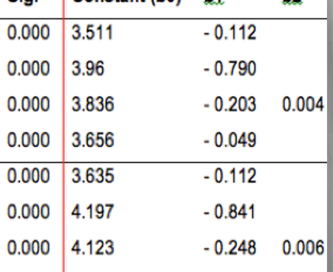




❑ INDOOR DRYING VERSUS OUTDOOR DRYING







CONCLUSION

A suitable multi-pesticide residue method was validated for measuring pesticides residues in incorporated and coated long-lasting nets. The total active ingredient in LNs decreases with the number of washes. The wash resistance of incorporated nets is higher compared to coated nets. A strong relationship between the release of the active ingredient from the LNs and the number of washing cycles was found not only for exponential model as can be found in the literature, but for the logarithmic model as well. LNs are proven to be well protected against UV by the way they are produced.