Paper impregnated with insecticides

The present invention relates to a paper impregnated with insecticidal active substances, to processes for its preparation and to its use for controlling insects.

It is known that for example what are known as vapour-producing tablets can be used for killing or repelling insects, for example mosquitoes, with the aid of electrical heating devices. In this method, suitable substances such as, for example, cellulose and cotton cardboard, asbestos, ceramics and/or porous resins are impregnated with insecticidal active substance solutions, to give insecticide tablets. The insecticides are evaporated by the effect of a heating device, which generates a temperature of from 120 to 190°C.

A substantial disadvantage of these vapour-producing tablets is that they do not provide a uniform release of the active substances over the envisaged duration of action. When they are taken into operation, the release of active substance is usually unnecessarily high and then drops continuously and sharply. The activity of these vapour-producing tablets diminishes in the course of the given service life.

Vapour-producing devices as described for example in GB-B-2 153 227 have also been known for some time for domestic premises; here, a solution is evaporated by means of an electrically heatable wick, the active substance being dissolved, for example, in a mixture of saturated aliphatic hydrocarbons.

When the product is used, the amount of organic solvent required in these so-called liquid evaporators, which is substantial in comparison with the amount of active substance, leads to an undesirably high solvent concentration in the room, which leads, inter alia, to the soiling of walls and objects in the vicinity of these devices, a fact which has frequently led to consumers' complaints.

To repel nuisance insects, battery-operated insecticide evaporators are known, where the surface of a radiator slab is heated to a temperature of between 90 and 130°C in order to evaporate an insecticide (DE 195 25 782 A1).

Moreover, DE 20 2004 008 226 U1 discloses fuel articles for controlling insects, in particular when barbecuing, which articles comprise a support provided with pores and/or interstices and a fuel consisting of wax and/or paraffin and/or stearine, the fuel having a citronella oil content.

Also known is the evaporation of insecticides with the aid of electrically operated fans which blow a stream of air over a support impregnated with an insecticidal active substance solution. Such fan systems are described for example in WO-A-96/32843.

EP-B- 0 279 325 discloses transfluthrin-impregnated natural and synthetic materials, including, for example, moth papers.

DE 199 47 146 A1 discloses support materials which are impregnated with 0.05 to 2 mg/cm^2 active substance from the series consisting of transfluthrin, pynamin forte, vaporthrin and prallethrin. The support materials are used at room temperature for controlling wind insects in enclosed spaces. As the result of the volatility of the insecticidal active substances, the latter escape from the support material and thus ensure a certain concentration of insecticidal active substance in the air. However, the disadvantage of the systems described in DE 199 47 146 A1 are that these systems firstly already release the insecticidal active substances upon prolonged storage, and that it is not clear to the user which activity a system which has already been stored will indeed display when the system is used at a later point in time. Secondly, the release of the insecticidal active substance out of the system is not sufficiently effective.

There are furthermore known smoke coils such as, for example, Baygon® coils, which protect against midges for a period of 6 to 12 hours, for example on the patio, on the balcony, while camping or in the room. For use, the rings are lit, during which process the ring glows away so that the active substance which it contains is released slowly and continuously in the open or in the room. A room approx. 20 m^2 in size requires one commercially available ring. However, the disadvantage of these rings is that they tend to break when used, so that only a part of them is employed.

In addition, aerosols or oil sprays are used for controlling insects in order to free enclosed spaces rapidly from insects. Spaces which have been treated thus can then be aired as long as the arrival of fresh insects can be prevented. However, the disadvantage of such systems is that the aerosol mist, or the oil spray mist, will not become sufficiently finely distributed in the rooms as the result of their bulk.

All these products share the feature of being technically and logistically complicated and slow, and thus expensive, to produce. Moreover, the preparation of aerosols, oil sprays and spirals which, globally, account for the bulk of the products, requires the use of enormous amounts of natural resources such as kerosene, propane/butane, wood meal adhesive, starch and various formulation auxiliaries. Furthermore, their use usually brings about the disposal, at a later point in time, of the relevant packagings such as, for example, tins, valves, plastic bottles, outer packagings and the like.

Taking into consideration the above-described prior art, the expert is therefore faced with the problem of providing a device for controlling insects which largely avoids the above-described disadvantages.

In a first embodiment, the solution of this problem starts from a device for controlling insects with a support which glows away.

The support is then characterized in that it is provided with at least one insecticidal active substance.

In accordance with the invention, there is therefore provided, in a first embodiment, the provision of a device for controlling insects which comprises a support capable of glowing away and provided with at least one insecticidal active substance, for example by impregnation. In accordance with the invention, the support is designed such that it, once lit with a flame, will, after extinguishing, for example by blowing out or a gust of wind, continue to glow away and will not extinguish completely. As the result of the glowing, the support releases the at least one insecticidal active substance, thereby controlling insects.

Support

For the purposes of the present invention, the support is not subject to any particular limitation, as long as it is capable of releasing, while glowing, the at least one insecticidal active substance.

A suitable support is, for example, a cellulose-based support. In this respect, an example which can be mentioned is a paper support which is described in greater detail further below within the scope of a preferred embodiment. Further cellulose-based materials are, for example, wood chippings, wood chips or sawdust, rice husks, maize cob spindles (preferably without kernels), pecan nut shells and peanut shells. Thin particle board, in particular, is also suitable as support material. A suitable cellulose-based support is described, for example, in the German patent application DE 43 223 76 A1, the disclosure of which is hereby included by reference.

Another possible support is based on textile materials. Such a support, in part or as a whole, may contain synthetic fibres such as, for example, made of polyester or nylon, or natural fibres such as cotton, viscose, a linen/viscose mixture, or a mixture of synthetic fibres and natural fibres, such as cellulose polyester (synthetic paper) or cotton polyester. Other examples are wool feltine and Trevira satin.

Another possible support is based on glowable plastic materials such as polycarbonates, polyesters, polyamides and polyterephthalates. Thus, it has emerged within the scope of the present invention that the support element for the insecticidal active substance can be made of a plastic material into which the active substance has been incorporated before the support element enters the final production or shaping process. This active substance is distinguished within the scope of the present invention by the characteristic of its activity being not, or only insubstantially, adversely affected

by the shaping process of the support element, while being capable of being released from the plastic support with an essentially constant evaporation rate as the support glows away. The method of choice for manufacturing the support is, in particular, the injection moulding method, where the insecticidal active substance, for example a pyrethroid, is admixed to a plastic starting material, for example a polycarbonate, and this mixture is then brought into the described final shape by working in an injection-moulding mould. Examples of an alternative manufacturing method are extruding or thermoforming.

Within the scope of the present invention, the use of a cellulose-based support is especially preferred.

Within the scope of the present invention, the use of a paper support is furthermore very especially preferred.

In a very especially preferred embodiment, the solution of the problem on which the present invention is based therefore starts from a device for controlling insects which comprises a glowable paper support.

The paper support is characterized in that it is provided with at least one insecticidal active substance.

In accordance with the invention, there is therefore provided, in this very especially preferred embodiment, the provision of a device for controlling insects which comprises a paper support capable of glowing away and provided with at least one insecticidal active substance, for example by impregnation. In accordance with the invention, the paper support is designed such that it, once lit with a flame, will, after extinguishing, for example by blowing out or a gust of wind, continue to glow away and will not extinguish completely. As the result of the glowing, the paper support releases the at least one insecticidal active substance, thereby controlling insects.

In a particular embodiment of this very especially preferred embodiment of the present invention, the device according to the invention consists of the support, in particular the paper support, the at least one insecticidal active substance and, if appropriate, further additives such as, for example, potassium nitrate. Further additives are described hereinbelow.

Cellulose-based supports - paper supports

In accordance with the first embodiment, the device according to the invention comprises a paper support. The paper support contains cellulose. Cellulose is understood as meaning, within the scope of the present invention, the biomass which results from the chemical digestion of plant fibres (in most cases wood) and which consists predominantly of cellulose.

Paper supports of the type according to the invention have already been known for many years, but not in the field of insect control. Thus, a paper support has been impregnated for approximately 150 years with the Asian tree resin "styrax", the resulting product being referred to as "Armenian paper". This "Armenian paper" is used for neutralizing food and tobacco odours or other unpleasant odours. The Frenchman Auguste Poncet had returned from a trip to Armenia with the resin, which is also used for the production of incense, and is therefore reminiscent of the latter's odour. The paper is sold in booklets with a varying number of sheets. When this paper is used, a leaf is removed from the booklet, lit in an ashtray and then extinguished so that it slowly glows away. Upon glowing away, the paper releases the desired aromatic substances and thus ensures a pleasant odour in the surroundings. The paper substrate according to the invention too is used in a similar manner.

In principle, the paper support used for this purpose is not subject to any particular limitations, as long as it is generally capable of absorbing at least one suitable insecticidal active substance and, after the paper support has been lit and gone out, of liberating the at least one insecticidal active substance without substantially leading to decomposition.

However, it has emerged that paper supports with a paper weight of preferably 25 to 300 g/m^2, in particular 25 to 270 g/m^2, especially preferably 25 to 250 g/m^2, very especially preferably 25 to 230 g/m^2, furthermore very especially preferably 25 to 215 g/m^2, specifically 25 to 200 g/m^2, are particularly suitable for the purpose according to the invention.

It is furthermore preferred when the thickness of the paper support is within a range of from 0.1 to 0.5 mm, especially preferably 0.15 to 0.45 mm, very especially preferably 0.15 to 0.40, furthermore very especially preferably between 0.15 and 0.34 mm, specifically 0.15 to 0.32 mm.

As regards the size of the individual paper supports, the present invention is not subject to any limitations. However, the paper support according to the invention should be present in ready-cut form so that it can be used, by the user, in a suitable way, i.e. that it has for example a size which makes it possible to let the paper support glow away in a container, for example an ashtray.

The paper support which, for example, can be used in accordance with the invention may take the form of, for example, a support made of paperboard, for example absorptive paperboards, cardboard or corrugated board.

Insecticidal active substance

A support, in particular a paper support, which is provided with only one insecticidal active substance may be used in the device according to the invention. Alternatively, it is also possible to

provide two or more insecticidal active substances simultaneously on the support, in particular the paper support, such as, for example, 2, 3 or 4 insecticidal active substances.

The selection of suitable insecticidal active substance is, in principle, only subject to the limitation that the insecticidal active substance is released into the surrounding atmosphere essentially without decomposition at the glowing temperature of the support, in particular the paper support, of approximately 350 to 600°C, without essentially losing its insecticidal activity. Within the scope of the present invention, the term "essentially without decomposition" is taken to mean that a decomposition of not more than 80%, preferably not more than 70%, especially preferably not more than 60%, particularly not more than 50%, specifically not more than 40%, takes place. In a first embodiment of the present invention, the paper substrate is impregnated with at least one insecticidal active substance selected from the group consisting of the pyrethroids, in particular selected from the group consisting of acrinathrin, allethrin, d-allethrin, d-trans-allethrin, d-cis-trans-allethrin, alphamethrin, bathrin, bifenthrin, bioallethrin, S-bioallethrin, bioallethrin S-cyclopentyl isomer, bioethanomethrin, biopermethrin, bioresmethrin, clocythrin, chlovaporthrin, cycloprothrin, cyfluthrin, beta-cyfluthrin, cyhalothrin, gamma-cyhalothrin, lambda-cyhalothrin, cypermethrin, alpha-cypermethrin, beta-cypermethrin, cis-cypermethrin, theta-cypermethrin, zeta-cypermethrin, cyphenotrin, deltamethrin, depallethrin, empenthrin, empenthrin (1R isomer), esbiothrin, esfenvalerate, etophenprox, fenfluthrin, fenpropathrin, fenpyrithrin, fenvalerate, flubrocythrinate, flucythrinate, flumethrin, fubfenprox, imiprothrin, kadethrin, metofluthrin, neopynamine, permethrin, cis-permethrin, trans-permethrin, phenothrin, phenothrin (1R-trans isomer), d-phenothrin, prallethrin, profluthrin, protrifenbute, pynamin forte, pyresmethrin, pyrethrin, resmethrin, cis-resmethrin, RU 15525, silafluofen, tau-fluvalinate, tefluthrin, tetramethrin (phthalthrin), tetramethrin (1R isomer), terallethrin, tralomethrin, transfluthrin, ZXI 8901, pyrethrins (pyrethrum) and any mixture of the abovementioned substances.

In a further embodiment, the insecticidal active substance can be selected from among the following active substances, it being possible to use the following insecticidal active substances alone or in any combination with one another and in any combination with the abovementioned insecticidal active substances.

Acetylcholine esterase (AChE) inhibitors

carbamates,

for example alanycarb, aldicarb, aldoxycarb, allyxycarb, aminocarb, bendiocarb, benfuracarb, bufencarb, butacarb, butocarboxim, butoxycarboxim, carbaryl, carbofuran, carbosulfan, cloethocarb, dimetilan, ethiofencarb, fenobucarb, fenothiocarb, formetanate, furathiocarb, isoprocarb, metam-sodium, methiocarb, methomyl, metolcarb, oxamyl, pirimicarb, promecarb, propoxur, thiodicarb, thiofanox, trimethacarb, XMC, xylylcarb, triazamate

organophosphates,

for example acephate, azamethiphos, azinphos (-methyl, -ethyl), bromophos-ethyl, bromfenvinfos (-methyl), butathiofos, cadusafos, carbophenothion, chlorethoxyfos, chlorfenvinphos, chlormephos, chloropyrifos (-methyl/-ethyl), coumaphos, cyanofenphos, cyanophos, chlorfenvinphos, demeton-S-methyl, demeton-S-methylsulphone, dialifos, diazinon, dichlofenthion, dichlorvos/DDVP, dicrotophos, dimethoate, dimethylvinphos, dioxabenzofos, disulfoton, EPN, ethion, ethoprophos, etrimfos, famphur, fenamiphos, fenitrothion, fensufothion, fenthion, flupyrazofos, fonofos, formothion, fosmethilan, fosthiazate, heptenophos, iodofenphos, iprobenfos, isazofos, isofenphos, isopropyl O-salicylate, isoxathion, malathion, mecarbam, methacrifos, methamidophos, methidathion, mevinphos, monocrotophos, naled, omethoate, oxydemeton-methyl, parathion (-methyl/-ethyl), phenthoate, phorate, phosalone, phosmet, phosphamidon, phosphocarb, phoxim, pirimiphos (-methyl/-ethyl), profenofos, propaphos, propetamphos, prothiofos, prothoate, pyraclofos, pyridaphenthion, pyridathion, quinalphos, sebufos, sulfotep, sulprofos, tebupirimfos, temephos, terbufos, tetrachlorvinphos, thiometon, triazophos, triclorfon, vamidothion

Sodium channel modulators / voltage-dependent sodium channel blockers

DDT

oxadiazines,

for example indoxacarb

semicarbazone,

for example metaflumizone (BAS3201)

Acetylcholine receptor agonists/antagonists

Chloronicotinyls,

for example acetamiprid, clothianidin, dinotefuran, imidacloprid, nitenpyram, nithiazine, thiacloprid, thiamethoxam

nicotine, bensultap, cartap

Acetylcholine receptor modulators

spinosyns,

for example spinosad

GABA-controlled chloride channel antagonists

organochlorines,

for example camphechlor, chlordane, endosulfan, gamma-HCH, HCH, heptachlor, lindane, methoxychlor

fiprols,

for example acetoprole, ethiprole, fipronil, pyrafluprole, pyriprole, vaniliprole

Chloride channel activators

mectins,

for example abamectin, emamectin, emamectin-benzoate, ivermectin, lepimectin, milbemycin

Juvenile hormone minetics,

for example diofenolan, epofenonane, fenoxycarb, hydroprene, kinoprene, methoprene, pyriproxifen, triprene

Ecdysone agonists/disruptors

diacylhydrazines,

for example chromafenozide, halofenozide, methoxyfenozide, tebufenozide

Chitin biosynthesis inhibitors

benzoylureas,

for example bistrifluron, chlofluazuron, diflubenzuron, fluazuron, flucycloxuron, flufenoxuron, hexaflumuron, lufenuron, novaluron, noviflumuron, penfluron, teflubenzuron, triflumuron

buprofezin

cyromazine

Inhibitors of oxidative phosphorylation, ATP disruptors

diafenthiuron

organotin compounds,

for example azocyclotin, cyhexatin, fenbutatin-oxide

Uncouplers of oxidative phoshorylation by interrupting the H proton gradient

pyrroles,

for example chlorfenapyr

dinitrophenols,

for example binapacyrl, dinobuton, dinocap, DNOC

Site-I electron transport inhibitors

METIs,

for example fenazaquin, fenpyroximate, pyrimidifen, pyridaben, tebufenpyrad, tolfenpyrad

hydramethylnon

dicofol

Site-II electron transport inhibitors

rotenone

Site-III electron transport inhibitors

acequinocyl, fluacrypyrim

Microbial disruptors of the insect gut membrane

Bacillus thuringiensis strains

Fat biosynthesis inhibitors

tetronic acids,

for example spirodiclofen, spiromesifen

tetramic acids,

for example spirotetramate, cis-3-(2,5-dimethylphenyl)-4-hydroxy-8-methoxy-1-azaspiro[4.5]dec-3-en-2-one

carboxamides,

for example flonicamid

octopaminergic agonists,

for example amitraz

Inhibitors of magnesium-stimulated ATPase,

propargite

nereistoxin analogues,

for example thiocyclam hydrogen oxalate, thiosultap-sodium

Ryanodin receptor agonists,

benzoic dicarboxamides,

for example flubendiamid,

anthranilamides,

for example rynaxypyr (3-bromo-N-{4-chloro-2-methyl-6-[(methylamino)carbonyl]phenyl}-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carboxamide)

biologicals, hormones or pheromones

azadirachtin, Bacillus spec., Beauveria spec., codlemone, Metarrhizium spec., Paecilomyces spec., Thuringiensin, Verticillium spec.

Active compounds with unknown or unspecific mechanisms of action

fumigants,

for example aluminium phosphide, methyl bromide, sulphuryl fluoride

antifeedants,

for example cryolite, flonicamid, pymetrozine

mite growth inhibitors,

for example clofentezine, etoxazole, hexythiazox

amidoflumet, benclothiaz, benzoximate, bifenazate, bromopropylate, buprofezin, quinomethionate, chlordimeform, chlorobenzilate, chloropicrin, clothiazoben, cycloprene, cyflumetofen, dicyclanil, fenoxacrim, fentrifanil, flubenzimine, flufenerim, flutenzin, gossyplure, hydramethylnone, japonilure, metoxadiazone, petroleum, piperonyl butoxide, potassium oleate, pyridalyl, sulfluramide, tetradifon, tetrasul, triarathene, verbutin

Within the scope of the present invention, an insecticidal active substance is also understood as meaning a repellent active substance, or synergists.

Active substances with a repellent action, too, can be used alone or in combination with other active substances, such as diethyltoluamide (DEET) and picanidin.

As regards the insecticidal active substance content, the support, in particular the paper support provided in accordance with the invention, is not subject to any particular limitation. However, it has proved to be preferred for the insecticidal active substance content to be 0.01 to 100.0 mg/24 cm^2 paper area, especially preferably 0.05 to 80 mg/24 cm^2 paper area, very especially preferably 0.1 to 60 mg/24 cm^2 paper area, furthermore very especially preferably 0.15 to 40 mg/24 cm^2 paper area, specifically 0.20 to 20 mg/24 cm^2 paper area, this being based in each case on a support, in particular a paper support, which has the abovementioned paper weight and the abovementioned paper thickness.

The support, in particular the paper support, in the insecticidal composition according to the invention may additionally contain further active substances. An essential component here is potassium nitrate, with the result that the support, in particular the paper, does not burn completely but glows away after lighting and subsequent extinguishing. The amount of potassium nitrate which is present in the support, in particular the paper support, according to the invention is, in principle, not subject to any limitation. However, it has proved to be preferred when the amount of potassium nitrate is 5 to 50 g/m^2, especially preferably 7 to 45 g/m^2, very especially preferably 9 to 40 g/cm^2, furthermore very especially preferably 10 to 35 g/cm^2, specifically 12 to 30 g/cm^2.

The supports, in particular the paper supports, to be used in accordance with the invention may additionally also contain natural and/or synthetic fragrances and organic and inorganic colorants.

Natural fragrances can be selected for example from the group consisting of musk, civet, ambergris, castereum and similar fragrances: ajowan oil, almond oil, ambrette seed absolute, angelica root oil, anisole, basil oil, bay oil, benzoin resinoid, essence of bergamot, birch oil, rosewood oil, ferula oil, cajeput oil, cananga oil, gapiscum oil, caraway oil, cardamom oil, carrot seed oil, cassia oil, cedar wood oil, celery seed oil, cinnamon bark oil, citronella oil, clary sage oil, clove oil, cognac oil, coriander oil, cubebene oil, camphor oil, dill oil, tarragon oil, eucalyptus oil, fennel oil sweet, calbanum resinoid, garlic oil, geranium oil, ginger oil, grapefruit oil, hop oil, hyacinth absolute, jasmine absolute, juniper berry oil, labdanum resinoid, lavender oil, bay leaf oil, lemon oil, lemon grass oil, lavage oil, mace oil, tangerine oil, Nfisoma absolute, myrrh absolute, mustard oil, narcissus absolute, neroli oil, nutmeg oil, oak moss absolute, olibanum resinoid, onion oil, opoponax resinoid, orange oil, orange flower oil, iris concrete, pepper oil, peppermint oil, balsam of Peru, petit grain oil, pine needle oil, rose absolute, rose oil, rosemary oil, sandalwood oil, sage oil, curly-

mint oil, styrax oil, thyme oil, tolu balsam, tonka bean absolute, tuberose absolute, oil of turpentine, vanilla pod absolute, vetiver oil, violet leaf absolute, ylang-ylang oil and similar plant oils and the like.

Synthetic fragrances which may be added to the support materials, in particular the paper supports, according to the invention are:

pinene, limonene and similar hydrocarbons, 3,3,5-trimethylcyclohexanol, linalool, geraniol, nerol, citronellol, menthol, borneol, borneylmethoxycyclohexanol, benzyl alcohol, anisal alcohol, cinnamyl alcohol, ß-phenylethyl alcohol, cis-3-hexanol, terpineol and similar alcohols; anethols, musk xylene, isoeugenol, methyleugenol and similar phenols; amylcinnamaldehyde, anisaldehyde, n-butyraldehyde, cuminaldehyde, cyclamenaldehyde, decylaldehyde, isobutyraldehyde, hexylaldehyde, heptylaldehyde, n-nonylaldehyde nonadienol, citral, citronellal, hydroxycitronellal, benzaldehyde, methylnonyl acetaldehyde, cinnamaldehyde, dodecanol, hexylcinnamaldehyde, undecanal, heliotropin, vanillin, ethylvanillin and similar aldehydes, methyl amyl ketone, methyl ß-naphthyl ketone, methyl nonyl ketone, musk ketone, diacetyl, acetylpropionyl, acetylbutyryl, carvone, methone, camphor, acetophenone, p-methylacetophenone, ionone, methylionone and similar ketones; amyl butyrolactone, diphenyl oxide, methyl phenylglycidate, nonylacetone, coumarin, cineol, ethyl methylphenylglycidate and similar lactones or oxides, methylformate, isopropyl formate, linalyl formate, ethyl acetate, octyl acetate, methyl acetate, benzyl acetate, cinnamyl acetate, butyl propionate, isoamyl acetate, isopropyl isobutyrate, geranyl isovalerate, allyl capronate, butyl heptylate, octyl caprylate, methyl heptinecarboxylate, methyl octinecarboxylate, isoamyl caprylate, methyl laurate, ethyl myristate, methyl myristate, ethyl benzoate, benzyl benzoate, methyl carbinylphenylacetate, isobutyl phenylacetate, methyl cinnamate, styracin, methyl salicylate, ethyl anisate, methyl anthranilate, ethyl pyruvate, ethyl butylbutyrate, benzyl propionate, butyl acetate, butyl butyrate, p-tert-butylcyclohexyl acetate, cedryl acetate, citronellyl acetate, citronellyl formate, p-cresyl acetate, ethyl butyrate, ethyl caproate, ethyl cinnamate, ethyl phenylacetate, ethylene brassylate, geranyl acetate, geranyl formate, isoamyl salicylate, isoamyl valerate, isobornyl acetate, linalyl acetate, methyl anthranilate, methyl dihydrojasmonate, nonyl acetate, ß-phenylethyl acetate, trichloromethylenephenylcarbinyl acetate, terpinyl acetate, vetiveryl acetate and similar esters. These fragrances can be used individually, or at least two of these can be used as a mixture with one another. In addition to the fragrance, the formulation according to the invention may, if appropriate, additionally contain the additives conventionally used in the fragrance industry, such as Patchouli oil or similar volatilization-inhibitory agents such as eugenol or similar viscosity-regulating agents.

The products according to the invention may also contain deodorizing agents such as, for example, lauryl methacrylate, geranyl crotonate, acetophenone myristate, p-methylacetophenone benzalde-

hyde, benzyl acetate, benzyl propionate, amylcinnamaldehyde, anisaldehyde, diphenyl oxide, methyl benzoate, ethyl benzoate, methyl phenyl acetate, ethyl phenyl acetate, neolin, safrol and the like.

The supports, in particular the paper supports, according to the invention can furthermore comprise synergists, such as octachlorodipropyl ether and piperonyl butoxide, either alone or in combination with the abovementioned insecticidal active substances.

Matrix

In addition, the insecticidal active substance can be present on the support, in particular the paper support, in a matrix. By using a matrix material in which the insecticidal active substance is included, it may be possible to ensure that the insecticidal active substance does essentially not escape after the production and before the use of the product according to the invention and that the product according to the invention thus does not change its consistency.

Suitable matrix materials are all those systems which prevent the at least one insecticidal active substance to be used in accordance with the invention from escaping from the support material, for example the paper support, under normal environmental conditions (23°C, 1013 mbar).

The organic materials which are suitable as matrix materials include polyvinyl alcohol, wheat protein and its derivatives, carbohydrates, starch (from different plant sources), amylose and its derivatives, amylopectin and its derivatives, cellulose and its derivatives, hydrolysed starch, modified starch, modified starch derivatives, maltodextrins, hydroxypropylmethylcellulose (HPMC), polyvinylpyrrolidone (PVP), chitin, chitosan, polysaccharide gums and their derivatives, polyethylene glycol, polyesters, hydroxyalkyl starch, polyvinylpyrrolidone/cellulose derivatives, casein, gelatine, solubilized proteins, polyacrylamides, polyamines, styrene/maleic anhydride resins, polyethyleneamine, xanthan gum.

Further examples which may be mentioned are polyacrylates, such as optionally crosslinked maleinized or epoxidized polymers and crosslinked (meth)acrylate polymers. Preferred are condensates of a maleinized or epoxidized polymer and a crosslinking agent, preferably a polyamine. Examples of suitable polymers are reaction products of polydienes, such as polybutadiene, polydecadiene and soya oil with a molecular weight of more than 400 g/mol with maleic anhydride, furthermore copolymers of olefins, such as ethylene with maleic anhydride, and epoxidized polybutadiene. Preferred crosslinking agents are polyamine, in particular polyoxypropylenediamine and polyoxypropylenetriamine. Other substances which are also suitable as crosslinking agents are triethylene glycol, polyethyleneimine and urea. The crosslinking reaction is preferably carried out in alcoholic solution, for example in dipropylene glycol, at elevated temperature. The maleic anhydride or ep-

oxide groups or the -NR-CO- groups of the crosslinked polymers and the -CRH-O- groups, which are provided by the polyoxyalkylene polyamine, have a hydrophilic effect.

Another class of crosslinked polymers are copolymers of monofunctional (meth)acrylate monomers, for example hydroxyethyl acrylate or poly(propylene oxide)(ethylene oxide) monomethacrylate, with a polyfunctional (meth)acrylate monomer, for example ethylene glycol dimethacrylate or polyethylene glycol 400 dimethacrylate. The preparation of the crosslinked (meth)acrylate polymers is accomplished by free-radical copolymerization of the monomers. In both cases, the crosslinked polymers are capable of absorbing liquids and gases, for example finely distributed insecticidal active substances, in liquid, dissolved or dispersed form.

Others which are suitable as matrix formers are solid alkanecarboxylic acids and gel-like metal salts of alkanecarboxylic acids. The following may be mentioned by preference: stearic acid and alkali metal salts of stearic acid, such as sodium stearate, and furthermore mixtures of stearic acid and palmitic acid or their alkali metal salts, for example mixtures of sodium stearate and sodium palmitate. Suitable matrix formers are described in DE 196 24 819 A1, whose relevant disclosure is incorporated into the present invention by reference.

Further examples which may be mentioned are inorganic materials, for example silica, polysilicates, polyphosphoric acid and its derivatives, polyboric acids, clay and the like.

In addition, it is also possible to use microencapsulated insecticidal active substances. As the result of the microencapsulation of the individual insecticidal active substances, an undesired release under standard room conditions can be avoided. Suitable systems are described in DE 100 22 989 A1, whose relevant disclosure is incorporated into the present invention by reference.

Preparation

The impregnated support materials, in particular paper support materials, which are to be used in accordance with the invention can be prepared using all customary impregnation methods, as long as the support, in particular the paper support, is not damaged during the impregnation procedure, for example by spraying the support with a solution of the insecticide, followed by drying, for example in the air, or by dipping the support into an insecticide solution, followed by drying, for example in the air. Other suitable impregnation methods are impregnation by means of a pipette, inkjet methods and screen-printing methods.

In one embodiment, the supports, in particular paper supports, of the insecticidal compositions according to the invention can therefore be prepared by soaking suitable support material, in particular paper, with a suitable solution or emulsion. Here, the starting materials used are preferably

supports, in particular paper supports, of the abovementioned specifications which are already provided with a suitable amount of potassium nitrate. In a further embodiment of the present invention, the support, in particular paper support, is provided with a glowing synergist. This may take the form of, for example, potassium nitrate or potassium permanganate.

Suitable solutions or emulsions with the at least one insecticidal active substance can be either water- or oil-based. In addition to the at least one insecticidal active substance, they comprise, if appropriate, further constituents such as, for example, potassium nitrate, antioxidants, for example phenol derivatives, in particular butylhydroxytoluene (BHT), butylhydroxyanisole (BHA), bisphenol derivatives, arylamines, such as, for example, phenyl-α-naphthylamine, a phenetidine/acetone condensate or similar or benzophenones, and emulsifiers, for example Span 80 or fatty acid esters.

Suitable organic and inorganic adjuvants are: ammonium salts and ground natural minerals such as kaolins, clays, talc, chalk, quartz, attapulgite, montmorillonite or diatomaceous earth, and ground synthetic minerals, such as highly disperse silica, alumina and silicates; suitable solid carriers for granules are: for example crushed and fractionated natural rocks such as calcite, marble, pumice, sepiolite, dolomite, and synthetic granules made of inorganic and organic meals, and granules of organic material such as sawdust, coconut shells, maize cobs and tobacco stalks; suitable emulsifying and/or foam-forming agents are: for example nonionic and anionic emulsifiers, such as polyoxyethylene fatty acid esters, polyoxyethylene fatty alcohol ethers, for example alkylaryl polyglycol ethers, alkylsulphonates, alkyl sulphates, arylsulphonates and protein hydrolysates; suitable dispersants are: for example lignin-sulphite waste liquors and methylcellulose.

Adhesives such as carboxymethylcellulose, natural and synthetic polymers in the form of powders, granules or latices can be used in the insecticide-containing gel formulations according to the invention, such as gum arabic, polyvinyl alcohol, polyvinyl acetate and natural phospholipids such as cephalins and lecithins and synthetic phospholipids. Further additives can be mineral and vegetable oils.

Colorants such as inorganic pigments, for example iron oxide, titanium oxide, Prussian Blue and organic dyestuffs such as alizarin, azo dyes and metal phthalocyanin dyes and trace nutrients such as salts of iron, manganese, boron, copper, cobalt, molybdenum and zinc can be used.

In a first embodiment, it is preferred to use a water-based solution or emulsion for applying the insecticidal active substances to the support, in particular paper support.

In a second embodiment, it is preferred to use an oil-based solution or emulsion for applying the insecticidal active substances to the support, in particular paper support, the solution preferably

being based on kerosene, such as, for example, Isopar, and paraffin-containing solvents, for example Isopar® (Exxon).

The insecticidal compositions according to the invention are particularly suitable for controlling flying insects, for example midges and flies, for example of the genus Musca domestica, for controlling moth, ants, mites, cockroaches and silverfish. For this purpose, the supports, in particular paper supports, are lit and immediately extinguished, so that they can then glow away, for example in a suitable container. The glowing-away time depends on the size of the support, in particular the paper support, and the amount of potassium nitrate on the support, in particular the paper support. Usually, the glowing times are from 1 minute to several hours, as a function of the support material, in particular the type and quality of the paper and the type of loading of the paper.

The insecticidal compositions according to the invention are particularly suitable for use in enclosed spaces, for example in rooms, cellars, stockrooms, stores, silos and animal houses. However, a use in the open, for example on the patio or for camping, is also possible within the scope of the present invention.

The present invention is illustrated in greater detail with reference to the examples which follow, but is not limited in any way to the use forms described in the examples.

1. Insect control test (1-m^3-test room)

1.1 Materials

Test insects:

1. Aedes aegypti, strain BioGenius 04, sensitive, 3 days old, both sexes
2. Culex quinquefasciatus, strain BioGenius 05, sensitive, 3 days old, both sexes

1.2 Equipment

Wire baskets:	length 8.5 cm, ∅ 8 cm
Plastic beakers:	∅ 9.5 cm, height 4.5 cm
Swabs:	cellulose
Sugar water:	10% granulated sugar (Pfeiffer & Langen) in tap water
Test chamber:	1 m^3 chamber with equipment

1.3 Environmental conditions

Temperature: 22°C

Relative humidity: 40%

Light: electrical lamps

1.4 Control means

a) Baygon rings:

0.03% transfluthrin (0.5 g corresponds to 0.15 mg transfluthrin)

b) Test paper (according to the invention)

Sheets of test paper with an area of 82.2 cm^2 are impregnated with 0.66 mg of transfluthrin. Paper supports with the following dimensions are used in the experiments:

(1) 35.7 cm^2 (corresponds to 0.290 mg transfluthrin)

(2) 27.9 cm^2 (corresponds to 0.225 mg transfluthrin)

(3) 18.6 cm^2 (corresponds to 0.150 mg transfluthrin)

1.5 Experimental procedure

Biological test with mosquito rings with a defined product quantity in 1-m^3-chambers with enclosed insects

Three baskets (length 8.5 cm, diameter 8 cm), each of which contains 20 test insects (age: 3 to 4 days), are placed in the upper third of glass test chambers with steel bottoms 0.84 m x 0.87 m x 1.37 m in size (internal dimensions; 1 m^3 capacity). A defined amount of paper support or ring (usually 0.5 g) is positioned into the centre of the bottom and lit at one end.

The time in which 10%, 50% and 95% of the insects are killed (KT 10, KT 50 and KT 95) is determined. The test insects remained in the chambers for 60 minutes. Then, the final number of killed insects was determined. All insects are removed from the containers and transferred into an insecticide-free transparent plastic container. The beakers are covered with perforated lids and provided with cellulose swabs which had been soaked in 10%

sugar solution. After the insects had been kept for 24 hours in this insecticide-free atmosphere, the mortality is determined.

The tests are repeated three to five times.

Modification: 100% mortality (knock-down) (KT 100) is determined instead of a 95% mortality (KT 95). As the result of first screening tests, the test is not repeated.

1.5 Results

Efficacy of impregnated paper support (according to the invention) in comparison with Baygon rings in 1-m^3-chambers against yellow-fever-causing mosquitoes Aedes aegypti strain BioGenius 04, sensitive

Product	mg active substance/m^3	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Paper support Active substance: transfluthrin	0.290	2'35''	3'13''	4'27''	100	100
	0.225	3'27''	4'25''	6'00''	100	100
	0.150	4'08''	4'48''	6'47''	100	100
Baygon Black ring 0.03% transfluthrin	0.150	4'37''	5'57''	7'40''	100	100
Paper support without active substance (control)	-	-	-	-	0	0

Efficacy of impregnated paper support (according to the invention) in comparison with Baygon rings in 1-m^3-chambers against yellow-fever-causing mosquitoes Culex quinquefasciatus Strain BioGenius 05, sensitive

Product	mg active substance/m^3	% Knock down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Paper support Active sub-stance: transflu-thrin	0.290	4'12''	4'57''	7'43''	100	70
	0.225	4'57''	5'37''	9'43''	100	70
	0.150	5'53'''	6'53''	10'17''	100	60
Baygon Black coil 0,03% transflu-thrin	0.150	6'13''	8'07''	15'47''	100	98
Paper support without active substance (con-trol)	-	-	-	-	0	0

1.6 Evaluation

A comparison of the above results demonstrates that the paper supports according to the invention produce a more rapid knock-down effect for Aedes agypti and Culex quinquefasciatus than the Baygon rings.

2. Insect control test (20-m^3-test room)

2.1 Materials

Test insects:

1. Aedes aegypti, strain BioGenius 04, sensitive, 3 days old, both sexes
2. Culex quinquefasciatus, strain BioGenius 05, sensitive, 3 days old, both sexes

2.2 Equipment

Wire baskets: length 8.5 cm, ∅ 8 cm

Plastic beakers: ∅ 9.5 cm, height 4.5 cm

Swabs:	cellulose
Sugar water:	10% granulated sugar (Pfeiffer & Langen) in tap water
Test room:	20 m^3 room with equipment, glass bowl with cradle for a coil, fan

2.3 Environmental conditions

Temperature:	23 - 26°C
Relative humidity:	40 - 47%
Light:	electrical lamps

2.4 Control means

a) Baygon rings:

0.03% transfluthrin (2.0 g corresponds to 0.6 mg transfluthrin)

b) Test paper (according to the invention)

The test paper sheets are prepared by impregnation with the following amounts of a solution which contains 3 mg transfluthrin in 1 ml of acetone.

(1) 0.6 mg transfluthrin (0.2 ml solution impregnated onto an 18.6-cm^2-sheet)

(2) 1.2 mg transfluthrin (0.4 ml solution impregnated onto a 27.9-cm^2-sheet)

(3) 2.4 mg transfluthrin (0.8 ml solution impregnated onto a 35.7-cm^2-sheet)

2.5 Experimental procedure

The experiments are carried out in a room as shown in Figure 1 which was 20 m^3 in size (l = 2.84 m, w = 2.33 m, h = 3.03 m), whose internal walls and roof cladding were made of steel (DIN 4571) and the room was provided with five windows. The ground consists of unglazed tiles. Three wire baskets (l = 8.4 cm, diameter = 8.0 cm, mesh size = 1.0 mm), each of which contains 20 test insects (age 3 to 4 days) are distributed in the test room starting on the ground at a level of 1.80 m and 0.45 m away from the respective side at positions A, B and C.

A ring is placed into a glass bowl which is arranged on a stand at a level of 0.5 m in the middle of the room. The ring is fixed to a commercial ring cradle and lit at one end. A fan (diameter 0.2 m) whose blades point upwards is located underneath the bowl and rotates over the entire test period at speed 1 (manufacturer: Progress (Italy), type: 956 5780-04 W 11, 220 volts, 25 watts, 50 Hz).

The time in which 10%, 50% and 95% of the insects are killed (KT 10, KT 50 and KT 95) is determined. The test insects remained in the room for 60 minutes. Then, the final number of killed insects was determined. All insects are removed from the containers and transferred into an insecticide-free transparent plastic container. The beakers are covered with perforated lids and provided with cellulose swabs which had been soaked in 10% sugar solution. After the insects had been kept for 24 hours in this insecticide-free atmosphere, the mortality is determined.

The tests are repeated three to five times.

2.6 Results

Aerosol efficiency of impregnated paper supports (according to the invention) in comparison with Baygon rings in 20-m^3-rooms against yellow-fever-causing mosquitoes Aedes aegypti strain BioGenius 04, sensitive

Product	mg active substance	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Paper support	0.6	3'53''	6'23''	8'20''	100	100
Active substance: transfluthrin		5'30''	7'07''	9'50''	100	100
		5'33''	7'32''	8'43''	100	100
		4'59''	7'01''	8'58''	100	100
	1.2	4'07''	4'53''	6'20''	100	100
		2'53''	4'07''	6'03''	100	100
		4'30''	5'43''	6'43''	100	100
		3'50''	4'54''	6'22''	100	100
	2.4	3'23''	3'47''	4'57''	100	100

		2'03''	2'40''	4'43''	100	100
		3'30''	4'17''	5'20''	100	100
		2'59''	3'35''	5'00''	100	100
Baygon-Rings	0.6	11'00''	14'17''	19'03''	100	100
0.03% transflu-thrin		6'57''	12'07'	18'30''	100	100
		3'30''	13'37''	17'17''	100	100
		9'16''	13'20''	18'17''	100	100
Paper support without active substance (con-trol)	-	-	-	-	0	0

Aerosol efficiency of impregnated paper supports (according to the invention) in comparison with Baygon rings in 1-m^3-chambers against yellow-fever-causing mosquitoes Culex quinquefasciatus strain BioGenius 05, sensitive

Product	mg active substance	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortal-ity after 24 hours
		KT 10	KT 50	KT 95		
Paper support	0.6	6'47''	10'47''	16'37''	100	100
Active sub-stance: transflu-thrin		8'43''	12'23''	16'10''	100	100
		7'07''	10'13''	13'47''	100	98
		7'32''	11'08''	15'31''	100	99
	1.2	5'13''	7'27''	12'13''	100	100
		4'23''	5'47''	10'17''	100	100
		6'00''	7'00''	12'03''	100	100
		5'12''	6'45''	11'31''	100	100
	2.4	4'00''	5'03''	7'57''	100	100
		3'07''	3'50''	5'03''	100	100

		3'53''	4'50''	6'10''	100	100
		3'40''	4'34''	6'23''	100	100
Baygon ring	0.6	15'47''	21'40''	37'30''	100	100
0.03% transflu-		21'40''	28'30''	36'33''	100	100
thrin		15'03''	21'40''	31'20''	100	90
		17'30''	23'57''	35'08''	100	97

2.7 Evaluation

A comparison of the above results demonstrates that the paper supports according to the invention have a more rapid knock-down effect than the Baygon® rings against Aedes agypti (factor 2 to 3.5) and Culex quinquefasciatus (factor 2 to 5).

3. Insect control test (20-m^3-test room)

3.1 Materials

Test insects:
1. Aedes aegypti, strain BioGenius 04, sensitive, 3 days old, both sexes
2. Culex quinquefasciatus, strain BioGenius 05, sensitive, 3 days old, both sexes

3.2 Equipment

Wire basket: length 8.5 cm, ∅ 8 cm

Plastic beakers: ∅ 9.5 cm, height 4.5 cm

Swabs: cellulose

Sugar water: 10% granulated sugar (Pfeiffer & Langen) in tap water

Test room: 20 m^3 room with equipment, glass bowl with cradle for a coil, fan

3.3 Environmental conditions

Temperature: 24 - 25°C

Relative humidity: 36 - 47%

Light: electrical lamps

3.4 Control means

Test paper (according to the invention)

The test paper sheets are prepared by impregnation with the following amounts of a solution which contains 3 mg transfluthrin in 1 ml of acetone.

(1) 0.15 mg transfluthrin (0.2 ml solution impregnated onto an 18.6-cm^2-sheet)

(2) 0.30 mg transfluthrin (0.4 ml solution impregnated onto a 27.9-cm^2-sheet)

(3) 0.60 mg transfluthrin (0.8 ml solution impregnated onto a 35.7-cm^2-sheet)

3.5 Experimental procedure

The experiments are carried out in a room as shown in Figure 1 which was 20 m^3 in size (l = 2.84 m, w = 2.33 m, h = 3.03 m), whose internal walls and roof cladding were made of steel (DIN 4571) and the room was provided with five windows. The ground consists of unglazed tiles. Three wire baskets (l = 8.4 cm, diameter = 8.0 cm, mesh size = 1.0 mm), each of which contains 20 test insects (age 3 to 4 days) are distributed in the test room starting on the ground at a level of 1.80 m and 0.45 m away from the respective side at positions A, B and C.

A ring is placed into a glass bowl which is arranged on a stand at a level of 0.5 m in the middle of the room. The ring is fixed to a commercial ring cradle and lit at one end. A fan (diameter 0.2 m) whose blades point upwards is located underneath the bowl and rotates over the entire test period at speed 1 (details: see hereinabove).

The time in which 10%, 50% and 95% of the insects are killed (KT 10, KT 50 and KT 95) is determined. The test insects remained in the room for 60 minutes. Then, the final number of killed insects was determined. All insects are removed from the containers and transferred into an insecticide-free transparent plastic container. The beakers are covered with perforated lids and provided with cellulose swabs which had been soaked in 10% sugar solution. After the insects had been kept for 24 hours in this insecticide-free atmosphere, the mortality is determined.

The tests are repeated three to five times.

3.6 Results

Aerosol efficiency of impregnated paper supports (according to the invention) in 20-m^3-rooms against yellow-fever-causing mosquitoes Aedes aegypti strain BioGenius 04, sensitive

Product	mg active substance	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Paper support	0.15	7'00''	9'13''	14'43''	100	95
Active substance: transfluthrin		6'32''	8'33''	12'10''	100	95
		4'47''	7'03''	8'47''	100	100
		6'26''	8'16''	11'53''	100	97
	0.30	3'38''	4'33''	5'40''	100	100
		3'27''	5'07''	7'50''	100	100
		4'13''	5'13''	6'47''	100	100
		3'46''	4'58''	6'46''	100	100
	0.60	2'43''	3'47''	5'03''	100	100
		2'40''	3'20''	4'57''	100	100
		3'20''	4'13''	5'28''	100	100
		2'54''	3'47''	5'09''	100	100

Aerosol efficiency of impregnated paper supports (according to the invention) in 1-m^3-chambers against yellow-fever-causing mosquitoes Culex quinquefasciatus strain BioGenius 05, sensitive

Product	mg active substance	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Paper support	0.15	21'40''	23'23''	-	18	40
Active sub-						

stance: transflu-		13'30''	-	-	37	45
thrin		9'33''	-	-	68	40
		14'54''	-	-	41	42.
	0.30	7'00''	9'13''	27'33''	95	75
		8'33''	14'43''	-	75	55
		8'13''	14'22''	-	87	65
		7'55''	12'46''	-	99	65
	0.60	4'33''	7'30''	16'27''	100	85
		4'27''	6'27''	13'47''	100	98
		6'20''	10'10''	19'20''	98	70
		5'07''	8'02''	16'31''	99	84

3.7 Evaluation

The above experiments show that the use of at least 0.6 mg transfluthrin is particularly suitable for rooms 20 m^3 in size.

4. Determination of the burning behaviour (glowing behaviour) of paper-based vapour-producing objects

4.1 Equipment

- Standard laboratory equipment
- Stopwatch
- 1-m^3-chambers or 20-m^3-chamber
- Fan (only for the 20-m^3-chamber test)
- Clamping device for fastening the test bodies
- Lighter
- Receiving dishes

4.2 Procedure

Before the beginning of the test, the test specimen is identified clearly.

The test specimens to be tested are inserted into the clamping device provided: care must be taken here that the test specimens are arranged in such a way that they do not come into any contact with other surfaces such as, for example, the ground or the receiving dishes, which has an adverse effect on the course of the test (glowing of the test specimen).

The test specimen is placed into the test chamber (1 m^3 or 20 m^3) and positioned in such a way that the test specimen can be observed over the entire test phase. In the case of tests in the 20-m^3-chamber, a fan can optionally be used for simulating air circulation (positioning F in Figure 3). The test specimen is lit with a lighter until a visible flame is obtained. The flame is immediately blown out so that the test specimen can continue to glow unaided. At the same time, the stopwatch with which the glowing time of the test specimen is determined is started. The test specimen is observed over the entire test period (glowing period), the following being observed:

- does the test specimen glow continuously from the beginning to the end
- does the test specimen glow uniformly or only in parts from the beginning to the end
- do parts of the test specimen fall off during the test

The measurement is carried out at least three times

4.3 Evaluation

The results of the test are entered into a table and evaluated. At least the following important factors are to be evaluated and to be shown in the form of a table:

- duration of the glowing phase (mean of three measurements)
- visual appearance during the glowing phase

4.4 Evaluation factors of the visual assessment

a = burns optimally from the beginning to the end

b = parts fall off during glowing

c = embers extinguished

sf= spark formation

4.5 Test chambers

a) 1-m^3-chamber test see Figure 2

b) 20-m^3-chamber test see Figure 3

5. Preparation of test specimens of glowable paper-based vapour-producing objects

5.1 Equipment

- Standard laboratory equipment
- Stopwatch
- V4A dishes (35 x 22 cm)
- Drying oven (up to 50°C)
- Photographers' roller press
- Eppendorf pipettes 20 – 500 µl (including pipette tips)
- Receiving dishes for photographers' roller press

5.2 Pretreatment of the paper

The paper determined for the pretreatment is cut to DIN A 4 size and identified clearly with the corresponding development number. The DIN A 4 paper sheet is weighed accurately (net weight).

Thereafter, 500 g of aqueous 6% strength KNO_3 solution are prepared. Care must be taken that deionized water is used for the preparation of the solution. The finished solution is identified with the corresponding development no. and transferred into a V4A dish with a total volume of approx. 1 l. The paper is immersed into the 6% strength KNO_3 solution. Care must be taken that all of the DIN A 4 paper sheet is immersed in the solution. After 20 minutes, the paper sheet is removed from the solution and pressed directly using a photographers' roller press in order to express the excess fluid from the paper.

After pressing, the paper sheet is dried to constant weight in the drying oven (at approx.50°C) and again weighed accurately (gross weight).

The finished pretreated paper sheet is cut into test specimen strips 12 x 2 cm in size and suitably identified.

5.3 Impregnation of the test specimen strip

Using an Eppendorf pipette, a defined volume of the active substance solution is placed on the test specimen strip. Care must be taken here that the total quantity is distributed uniformly over the surface. The impregnated test specimen strip is identified with the relevant development no. and sealed hermetically into aluminium foil. After an exposure time of no less than 24 hours, the test specimen strip can be removed from the aluminium foil for the relevant tests. It is important that the sufficient amount is prepared per test specimen strip in order to be able to carry out the intended tests such as proof for biological activity and accompanying analyses. Test specimens which are used at a later point in time are stored in a refrigerator.

5.4 Evaluation of the KNO_3 quantity

The evaluation of the KNO_3 quantity is carried out as follows:

- **Amount KNO_3 / DIN A 4 sheet**

  Gross weight paper sheet – net weight paper sheet = amount of KNO_3

- **gsm substance KNO_3**

  Amount KNO_3 per sheet x 1 m^2 / area DIN A 4 sheet = KNO_3/m^2

6. Efficacy of various active substances

6.1 Test samples

1.– 4. Paper impregnated with various active substances
(paper size 1.8 cm x 15.7 cm = 28.3 cm^2)

1. Transfluthrin: application rate: 0.60 mg
2. Metofluthrin: application rate: 0.20 mg

3. Etoc: application rate: 0.60 mg
4. Pynamin forte: application rate: 4.00 mg
5. Control: paper without active substance

6.2 Test insects:

1. Aedes aegypti, strain BioGenius 04, sensitive, 3 days old, both sexes
2. Culex quinquefasciatus, strain BioGenius 05, sensitive, 3 days old, both sexes

6.3 Equipment

Wire baskets	length 8.5 cm, ∅ 8 cm
Plastic beakers:	∅ 9.5 cm, height 4.5 cm
Swabs:	cellulose
Sugar water:	10% granulated sugar (Pfeiffer & Langen) in tap water
Test room:	20 m^3 room with equipment, glass bowl with cradle for a coil, fan

6.4 Environmental conditions

Temperature:	23 - 25°C
Relative humidity:	35 - 57%
Light:	electrical lamps

6.5 Number of samples

5 pieces of paper

6.6 Experimental procedure

The experiments were carried out in a room which was 20 m^3 in size (l = 2.84 m, w = 2.33 m, h = 3.03 m), whose internal walls and roof cladding were made of steel (DIN 4571) and the room was provided with five windows. The ground consists of unglazed tiles. Three wire baskets (l = 8.4 cm, diameter = 8.0 cm, mesh size = 1.0 mm), each of which contains 20 test insects (age 3 to 4 days), are distributed in the test room starting on the ground at a level of 1.80 m and 0.45 m away from the respective side at positions A, B and C (see Figure 1).

A ring is placed into a glass bowl which is arranged on a stand at a level of 0.5 m in the middle of the room. The ring is fixed to a commercial ring cradle and lit at one end. A fan (diameter 0.2 m) whose blades point upwards is located underneath the bowl and rotates over the entire test period at speed 1.

The time in which 10%, 50% and 95% of the insects are killed (KT 10, KT 50 and KT 95) is determined. The test insects remained in the room for 60 minutes. Then, the final number of killed insects was determined. All insects are removed from the containers and transferred into an insecticide-free transparent plastic container. The beakers are covered with perforated lids and provided with cellulose swabs which had been soaked in 10% sugar solution. After the insects had been kept for 24 hours in this insecticide-free atmosphere, the mortality is determined.

The tests are repeated three to five times.

6.7 Results

Table 1

Aerosol efficiency of impregnated paper in 20-m³-test chambers against sensitive Aedes aegypti

Temperature: 23 – 25°C, Relative humidity: 35 – 57%

Paper	mg active substance	% knock-down in minutes (') and seconds ('')			% KD after 1 h	% mortality after 24 h
		KT 10	KT 50	KT 95		
Active substance: **Transfluthrin**	0.60	4'53"	5'37"	6'40"	100	100
		3'30"	3'47"	4'28"	100	100
		3'53"	4'28"	5'30"	100	100
		4'05"	**4'37"**	**5'33"**	**100**	**100**
Active substance: **Metofluthrin**	0.20	4'35"	5'28"	7'05"	100	100
		2'58"	3'48"	5'03"	100	100
		3'47"	4'43"	5'58"	100	100
		3'47"	**4'40"**	**6'02"**	**100**	**100**
Active substance: **Etoc**	0.60	5'50"	7'23"	10'33"	100	97
		5'27"	7'33"	9'13"	100	98
		4'30"	5'15"	5'55"	100	97
		5'16"	**6'44"**	**8'34"**	**100**	**97**
Active substance: **Pynamin forte**	4.00	4'10"	5'15"	7'00"	100	100
		3'00"	3'37"	4'30"	100	100
		2'50"	3'58"	4'37"	100	100
		3'20"	**4'17"**	**5'22"**	**100**	**100**
Control: Paper without active substance	---	---	---	---	0	20
		---	---	---	0	20
		---	---	---	0	20
		---	**---**	**---**	**0**	**20**

Table 2

Aerosol efficiency of impregnated paper in 20-m³-test chambers against sensitive Culex quinquefasciatus

Temperature: 23 – 25°C

Relative humidity: 35 – 57%

Paper	mg active substance	% knock-down in minutes (') and seconds ('')			% KD after 1 h	% mortality after 24 h
		KT 10	KT 50	KT 95		
Active substance: **Transfluthrin**	0.60	5'43"	6'53"	10'00"	100	100
		4'37"	4'57"	5'30"	100	100
		7'10"	10'27"	17'33"	97	100
		5'50"	**7'26"**	**11'01"**	**99**	**100**
Active substance: **Metofluthrin**	0.20	8'20"	10'37"	14'10"	97	60
		4'50"	5'50"	9'40"	100	98
		6'30"	7'33"	10'23"	100	95
		6'33"	**8'00"**	**11'24"**	**99**	**84**
Active substance: **Etoc**	0.60	9'07"	10'43"	14'00"	95	30
		11'53"	16'07"	29'00"	92	40
		6'33"	8'50"	14'27"	97	35
		9'11"	**11'53"**	**19'09"**	**95**	**35**
Active substance: **Pynamin forte**	4.00	5'22"	6'07"	8'13"	100	15
		6'33"	7'27"	10'57"	98	30
		5'13"	6'13"	9'10"	95	20
		5'43"	**6'36"**	**9'27"**	**98**	**22**
Control: Paper without active substance	---	---	---	---	0	0
		---	---	---	0	0
		---	---	---	0	0
		---	**---**	**---**	**0**	**0**

6.8 Results

All impregnated paper pieces (0.6 mg transfluthrin, 0.2 mg metofluthrin, 0.6 mg Etoc or 4.0 mg Pynamin forte) had a rapid knock-down effect on Aedes aegypti, in the following order:

95% knock-down time:	Pynamin forte:	5 minutes, 22 seconds
	Transfluthrin:	5 minutes, 33 seconds
	Metofluthrin:	6 minutes, 02 seconds
	Etoc:	8 minutes, 34 seconds

All paper pieces resulted in a high mortality rate: (Pynamin forte, transfluthrin and metofluthrin 100% mortality; Etoc 97% mortality).

All impregnated paper pieces (0.6 mg transfluthrin, 0.2 mg metofluthrin, 0.6 mg Etoc or 4.0 mg Pynamin forte) had a rapid knock-down effect on Culex quinquefasciatus, in the following order:

95% knock-down time:	Pynamin forte:	09 minutes, 27 seconds
	Transfluthrin:	11 minutes, 01 seconds
	Metofluthrin:	11 minutes, 24 seconds
	Etoc:	19 minutes, 09 seconds

The products differed significantly regarding the mortality rate of Culex mosquitoes. Only transfluthrin gives 100% mortality, followed by metofluthrin (84%), Etoc (35%) and Pynamin forte (22%).

7. Culture conditions for the insect species used

7.1 Culex quinquefasciatus

The mosquitoes are kept in cages (48 x 48 x 39 cm) with gauze panels in the sides and in the lid. The illumination (day/night rhythm) is controlled via a timer (12 hours light / 12 hours darkness), at a temperature of 26°C ± 1°C and a relative atmospheric humidity of 60% ±10%. To allow the mosquitoes to take up fluid, a cotton wool ball soaked in 10% strength glucose solution is placed into the box. Artificial blood feeds are given twice per week. Cattle blood mixed with an anticoagulant is warmed to 40°C with the aid of a magnetic stirrer. Approx. 50 ml of this blood is filled into a length of pigs' gut and then placed into the culture box. This allows the mosquitoes to take up blood. For oviposition, a dish

(diameter 10 cm) filled with tap water to a level of 2 cm is placed into the culture box. The deposited eggs are transferred into a plastic dish (25 x 37 cm) which is filled with 5 litres of demineralized water and which has been placed onto a heating pad for terraria. The mosquito larvae are fed once per day with commercially available dry feed for ornamental fish (for example Vita®). After approx. 6 days, they have reached the pupal stage. For the mosquitoes to hatch, the pupae together with a small amount of water are transferred into 10-litre plastic buckets. The hatching mosquitoes can then be caught for tests or for breeding.

7.2 Aedes aegypti

The mosquitoes are kept in cages (48 x 48 x 39 cm) with gauze panels in the sides and in the lid. The illumination (day/night rhythm) is controlled via a timer (12 hours light / 12 hours darkness), at a temperature of 26°C ± 1°C and a relative atmospheric humidity of 60% ±10%. To allow the mosquitoes to take up fluid, a cotton wool ball soaked in 10% strength glucose solution is placed into the box. Artificial blood feeds are given twice per week. Cattle blood mixed with an anticoagulant is warmed to 40°C with the aid of a magnetic stirrer. Approx. 50 ml of this blood is filled into a length of pigs' gut and then placed into the culture box. This allows the mosquitoes to take up blood. For oviposition, filter paper tubes 10 cm in height are placed into dishes (250 ml) which are filled with tap water to half their height. After oviposition, these tubes are stored in plastic buckets. To prevent drying out of the eggs, the bottom is previously covered with a moist cellulose layer 3 cm in height. For the mosquito larvae to hatch, approximately half of a paper filter which had previously been stored for 2 – 4 weeks is immersed in a plastic dish (25 x 37 cm) which is filled with 5 litres of demineralized water and which is placed on a heating pad for terraria. The mosquito larvae are fed once per day with commercially available dry feed for ornamental fish (for example Vita®). After 4-5 days, they have reached the pupal stage. For the mosquitoes to hatch, the pupae together with a small amount of water are transferred into 10-litre plastic buckets. The hatching mosquitoes can then be caught for tests or for breeding.

8. Comparison of the efficiency of aerosol and paper support according to the invention

8.1 Materials

Test insects: 1. Aedes aegypti, strain BioGenius 04, sensitive, 3 days old, both sexes

2. Culex quinquefasciatus, strain BioGenius 05, sensitive, 3 days old, both sexes

8.1 Equipment

Wire baskets:	∅ 8 cm, height 4.5 cm
Plastic beakers:	∅ 9.5 cm, height 4.5 cm
Swabs:	cellulose
Sugar water:	10% granulated sugar (Pfeiffer & Langen) in tap water

8.2 Environmental conditions

Temperature:	21°C
Relative humidity:	40 - 56%
Light:	electrical lamps

8.3 Insecticidal composition

Transfluthrin	0.5 / 0.25 / 0.1 / 0.05 / 0.025 / 0.01 active substance / m^3

8.4 Procedure

Three baskets (length 8.5 cm, diameter 8 cm), each of which contains 20 test insects (age: 3 to 4 days), are placed in the upper third of glass test chambers with steel bottoms 0.84 m x 0.87 m x 1.37 m in size (internal dimensions; 1 m^3 capacity).

A certain amount of the active substances is dissolved in 2 cm^3 of acetone and the solution is sprayed onto the bottom of the chamber.

The time in which 10%, 50% and 95% of the insects are killed (KT 10, KT 50 and KT 95) is determined. The test insects remained in the chambers for 60 minutes. Then, the final number of killed insects was determined. All insects are removed from the containers and transferred into an insecticide-free transparent plastic container. The beakers are covered with perforated lids and provided with cellulose swabs which had been soaked in 10% sugar solution. After the insects had been kept for 24 hours in this insecticide-free atmosphere, the mortality is determined.

8.5 Results

Aerosol efficiency in 1-m^3-chambers for yellow-fever-causing mosquitoes Aedes aegypti, strain BioGenius 04, sensitive

Product	mg active substance/m^3	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Transfluthrin	0.500	38''	51''	1'08''	100	100
	0.250	43''	1'01''	1'16''	100	100
	0.100	51''	1'21''	2'04''	100	100
	0.050	1'07''	1'49''	3'27''	100	100
	0.025	1'31''	2'15''	7'15''	100	89
	0.010	2'26''	> 10'44''	-	69	71

Aerosol efficiency in 1-m^3-chambers for yellow-fever-causing mosquitoes Culex quinquefasciatus, strain BioGenius 05, sensitive

Product	mg active substance/m^3	% knock-down after minutes (') and seconds ('')			% knock-down after 1 hour	% mortality after 24 hours
		KT 10	KT 50	KT 95		
Transfluthrin	0.500	1'37''	2'08''	4'09''	100	100
	0.250	1'47''	2'22''	5'02''	100	100
	0.100	2'11''	3'23''	10'44''	100	100
	0.050	15'16''	37'59''	-	50	80
	0.025	14'49''	-	-	33	53
	0.010	-	-	-	1	50

A comparison demonstrates that an aerosol application generally requires 0.1 mg/m^3 Transfluthrin, while the devices according to the invention already have an efficacy at 0.03 mg/m^3.

Patent Claims:

1. Insect control device which comprises a glowable support, characterized in that it is provided with at least one insecticidal active substance.

2. Device according to Claim 1 which comprises a glowable paper support which is provided with at least one insecticidal active substance.

3. Device according to Claim 2, characterized in that the paper support has a paper weight of 25 to 300 g/m^2.

4. Device according to Claim 2 or 3, characterized in that the thickness of the paper support is 0.1 to 0.5 mm.

5. Device according to one of Claims 2 to 4, characterized in that the insecticidal active substance content is 0.01 to 100.0 mg/24 cm^2 paper area.

6. Device according to one of Claims 2 to 5, characterized in that the paper support comprises potassium nitrate in an amount of from 5 to 50 g/m^2.

7. Method of preparing a device according to one of Patent Claims 2 to 6, characterized in that the insecticide-containing paper support is prepared by impregnating, in particular by spraying, the support with a solution of the insecticide and subsequently drying it, by immersing the support in an insecticide solution and subsequently drying it, by impregnation by means of a pipette, by ink-jet method or by screen-printing methods.

8. Use of the device according to one of Claims 1 to 6 for controlling insects.