

Witness to Drug Abuse

A small drop of saliva is all the Dräger DrugTest 5000 needs to conduct a rapid check to detect whether a person is under the influence of specific illegal substances. The system exploits the fact that saliva reflects the concentration of drugs in the blood – except cannabis, for which an extra step is required.



A driver is behaving suspiciously. Is he or she under the influence of illegal drugs? This is a question that is increasingly being confronted by traffic police. The latest data from traffic controls indicate that more and more people are driving under the influence of drugs. "It's a major hazard to road users and the public at large. Drugs seriously impair both physical and mental fitness to drive. It's not a trivial matter by any means," warns Dr. Stefan Tönnies, Head of Forensic Toxicology at the University of Frankfurt's Institute of Forensic Medicine.

HIGH ACCEPTANCE

In Germany, road users under the influence of drugs are most likely to have consumed cannabis, whose active agent is tetrahydrocannabinol (THC), though other substances such as opiates (heroin), cocaine, amphetamine, methamphetamine, and related designer drugs have also been detected in drivers. It is important for police to be able to determine rapidly and reliably whether a person is under the influence of an illegal substance. All they now require is a drop

of saliva – or, to be precise, 0.28 milliliters if the analysis is conducted with the rapid test kit developed by Dräger.

"Provided the sample is fresh, that's all the saliva you need to be able to tell within a couple of minutes whether a person is under the influence of one or more of the illegal drugs in common use," explains Dr. Stefan Steinmeyer, whose responsibilities include Business Development at Dräger's Drug Detection unit. In addition to the substances listed above, the test strips also react to benzodiazepines. Dräger has also developed a version that reacts to methadone instead of methamphetamine. This is for use with participants of methadone substitution programs, where tests are conducted to check for the concomitant use of illegal drugs.

The Dräger test kit has a crucial advantage compared to the urine-based test procedures commonly in use: In terms of taking and analyzing the sample, saliva is much easier to handle for all concerned. This is true of both traffic controls and

tests for the treatment of addiction. According to Dr. Andreas Ewald, Head of Toxicology at the University of Saarland's Institute of Forensic Medicine in Homburg, saliva-based tests therefore enjoy a much higher acceptance among both the police and those being tested. "The saliva test, which is preliminary and voluntary, involves a much smaller invasion of privacy than a urine sample," says Ewald, drawing on the experience he has gained while accompanying the Saarland police



Enough: Blue indicates that sufficient saliva has been collected.

Some tests detect the drug, others detect its decomposition products

on traffic controls since October 2009. Furthermore, as he explains, a saliva sample can be produced more quickly than a urine sample. And because it's a noninvasive procedure, the test can be performed at the roadside, unlike a blood test.

SALIVA IS NOT THE SAME AS SPITTLE

For a sample to be reliable, the saliva must be as freshly secreted as possible. "Saliva is not the same thing as the fluid in the mouth," explains Ewald, the forensic toxicologist and pharmaceutical analyst. "That also contains the remains of food and drink, as well as oral flora." The best way to obtain a high-quality sample is therefore to swab the inside of the oral cavity. For this purpose, the Dräger DrugTest 5000 uses an oral fluid collector made of a rigid, porous material that can absorb a precisely defined amount of saliva. The test subject places this inside his or her own mouth and wipes it back and forth on the mucous membrane of the oral cavity, thus ensuring that the sample is taken close to the glands where it is secreted. An indicator turns blue when a sufficient amount has been collected.

But how do drugs find their way into saliva in the first place? The mouth of a grown person produces as much as 1.5

liters of this watery fluid every day. Saliva is secreted by the submandibular gland, the parotid gland, and the sublingual gland as well as a series of smaller salivary glands. The submandibular gland is responsible for around 65 percent of saliva production, the parotid gland for around 23 percent, and the sublingual gland for around four percent. The remaining eight percent or so is secreted by some 750 small salivary glands located in the membranes lining the oral cavity and the pharynx. From a toxicological point of view, the crucial fact about saliva is that it is derived from the blood – 99 percent of it consists of water that has entered the salivary glands via the blood vessels. This water also contains a variety of dissolved substances, possibly including the active agents of drugs and their decomposition products, which therefore enter the saliva and, by this means, the oral cavity and pharynx.

SALIVA, BLOOD, URINE

Compared to the urine test normally used in such situations, the saliva test is therefore substantially different not only because it is easier to use but also, and most importantly, because of what it actually reveals. A urine test can detect drugs for a relatively long period after consumption – primarily because of the



Unambiguous results on an easily readable display.

high concentration of decomposition products of the active agents in the sample. However, if there is a need to show recent consumption and the direct influence of illegal substances, a saliva test is more suitable. This is because it provides information about the concentration of the active agent in the blood.

Is it therefore possible to search directly for the active agents of drugs in saliva? That's not quite so simple. "The body processes different drugs in different ways," explains Tönnies. "In the case of some illegal substances, the test therefore has to be able to detect not only the active agent but also its decomposition products." The test for cocaine reveals both traces of the drug itself and its



ST-13214-2007



ST-13220-2007



ST-13221-2007

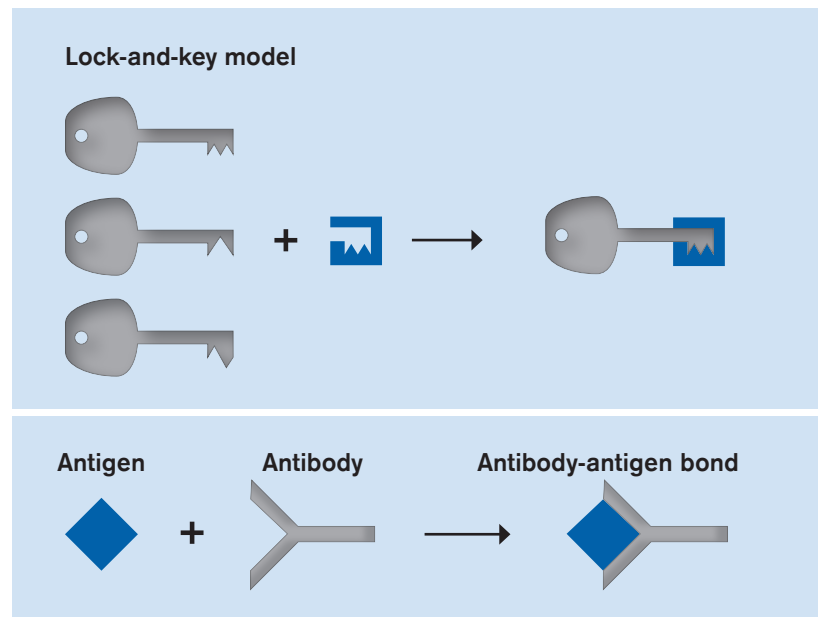
To test for drugs, the oral fluid collector is slotted into the Dräger DrugTest 5000. The analysis is conducted under controlled conditions and evaluated using an optoelectronic system.

decomposition products, whereas heroin is practically always detected only on the basis of its decomposition products. This is because the diacetylmorphine in heroin is metabolized, first to 6-monoacetylmorphine and then to morphine, within a few minutes of consumption.

By analyzing saliva, however, it is possible to infer that such processes have occurred in the blood. This is because of the so-called concentration gradient that exists between blood and saliva when the one contains a greater concentration of a dissolved substance than the other. The result is that the solute migrates down the gradient toward the solvent with the lower concentration. In other words, if the active agent of an illegal substance or one of its decomposition products is present in the blood, this will result in a corresponding concentration in the saliva, even if there is no absolute correlation between the two values. “If a rapid test is what you want, saliva is indeed the closest medium to blood,” says Ewald. Also important is the fact that a saliva test can provide evidence of drug consumption even if the drug has not been taken orally.

THE CHALLENGE OF THC

Intravenous injection, smoking, snorting, and swallowing are the most common methods of taking illegal drugs. Drugs injected intravenously enter the bloodstream directly. In the case of smoking, tiny particles of the active substance are absorbed via the lungs, whereas with snorting or swallowing the drug passes into the body via the mucous membranes in the nasal cavity and via the stomach and small intestine, respectively. The method of consumption determines how much of



A unique match: The lock-and-key model describes the bond between an antibody and a specific antigen.

Using antibodies to detect drugs

A rapid test for drugs needs to deliver quick and precise results on the basis of a small sample. A procedure known as immunoassay is used to detect the active substance of a drug and its decomposition products. This method identifies the presence of a substance on the basis of antibodies specific to that substance. These antibodies are proteins that are responsible in the immune system of vertebrates for defense reactions against pathogens, as a rule. What distinguishes them is that they are highly selective and only bind to the molecules of a certain substance, which is then termed the antigen of that antibody.

The reactions between antibodies and antigens have been used for diagnostic purposes and other tests for around 50 years now. The standard method here is known as solid-phase immunoassay, in which the antibodies are bound to a solid surface. This surface is then exposed to the sample in order to test for the presence of the specific antigen (also termed the analyte or target substance). The reaction between an antibody and its target substance is also the basis of the signal that is evaluated by the analysis.

The Dräger DrugTest 5000 uses immunoassays according to the principle of competition. Molecules of the substance to be identified by the test are fixed to the membrane of the test strip. In the analysis, the sample is brought into contact with antibodies and then run across the membrane. If the target substance is not present in the sample, the color-marked antibodies bind to the molecules attached to the membrane. This reaction can be detected and evaluated optoelectronically using light sensors.

If, on the other hand, the sample does contain the target substance, antibodies bind immediately to the latter, and the reaction in the test zone on the membrane either does not occur or is correspondingly weaker. In other words, a strong signal (powerful reaction) indicates that the test is negative. In the case of the Dräger DrugTest 5000, the detection sensitivity of this method is a few nanograms of analyte per milliliter of saliva.

the drug actually enters the bloodstream and thereby acts upon the central nervous systems. When drugs are swallowed, for example, the liver already breaks down a portion of the active agent when it is absorbed via the digestive tract.

Yet there is one exception to the rule that saliva always provides an indication of the concentration of an illegal drug in the bloodstream. In the case of THC – i.e. the active agent of the illegal drug most frequently consumed by drivers – only extremely small amounts are transported from the bloodstream to the saliva.

Here, however, development engineers at Dräger were able to exploit the fact that when cannabis is consumed, traces of the lipophilic THC molecules are detectable in the mucous membranes of the oral cavity and the pharynx for the same

length of time as the drug remains active in the body. “The correlation is tenable, even though the current state of research indicates that it’s fortuitous,” says Tönnies. Studies have demonstrated a correspondence of 85 to 90 percent between the results of saliva tests with the Dräger DrugTest 5000 and blood tests for THC.

RAPID RESULTS

Both the test cassette containing the fluid collector and the analyzer have been designed by Dräger to permit the reliable detection of oral contamination with THC. It takes eight minutes for the test kit to deliver positive proof of cannabis consumption; five minutes are required for other drugs.

In all cases, the procedure is identical. Once the fluid collector has been filled with saliva, the test cassette is slotted into

the analyzer. A buffer solution rinses the sample out of the porous tip of the collector, and the analyzer dips the special test strip into the solution. The ensuing immunochemical reactions are analyzed within a few minutes by means of an optoelectronic method, and the results are shown on an illuminated display.

The testing device is internally climate-controlled, which means that the tests can be carried out in the rain, during the hours of darkness, and outdoors. All of these are important considerations for a system that is designed for use by traffic police, among other applications. As a result, all it really takes to achieve a reliable result is a little patience – and a drop of saliva.

Oskar Meyer

HEADQUARTERS

Dräger Safety AG & Co. KGaA
Revalstrasse 1
23560 Lübeck, Germany

www.draeger.com

SUBSIDIARIES

CANADA

Dräger Canada Ltd.
7555 Danbro Crescent
Mississauga,
Ontario L5N 6P9
Tel +1 905 821-8988
Fax +1 905 821-2565

Customer Service
Tel 877 372 4371
Fax 800 329 8823

MEXICO

Draeger Safety S.A. de C.V.
Carretera San Luis Potosi Km 21
Bodega No. 1 y 2
“Condominio Industrial
Santa Rosa Bloque SMED”
Querétaro
Oro México CP 72220
Tel +52 442 246-1113
Fax +52 442 246-1114

USA

Draeger Safety, Inc.
101 Technology Drive
Pittsburgh, PA 15275
Tel +1 412 787-8383
Fax +1 412 787-2207

Customer Service
Tel 800 858 1737
Fax 800 922 5519

Technical Service
Tel 888 794 3806
Fax 888 794 3807