According to the experts, however, the grounds for the relatively small acceptance by farmers is in the main (93%) fear of reduced yields (see yield estimations by the experts). Other reasons given include the following of tradition and insufficient knowledge of the system with 88%, whilst the limited risk-taking willingness of farmers was rated at 85% . There then followed other reasons such as insufficient production cost analyses (76% of nominations) and high introductory costs (73%). In the middle were arranged insufficient technology (68%) and not enough scientific results (65%) and lack of economical necessity (62%).

From the NB expert's answers, the motivation structure had slightly different tendencies. Whilst here too, the major reasons lack of acceptance with an average rated frequency of 72% of no-till was tradition, fear of yield penalties, reduced risk-taking willingness and high capital investment in machinery, following closely in the middle range of the ratings were the reaction of the neighbours (67%) and landlord reaction (56%). With a share in each case of 44% were the grounds of no economic necessity and lack of analyses of production costs. In comparison, the motives of insufficient scientific results and lack of appropriate technology played hardly any role in the relatively small acceptance according to EU expert opinion (68%) with a rated frequency of 33% and 22%.

#### Effects of direct drilling

Regarding the closing questions on the long-term effects of direct drilling on farm income (*fig. 2*), 49.5% of the surveyed direct drillers in the EU judged that this would increase, 36% saw income remaining at the same level and only 6.3% were of the opinion that the income would reduce in comparison with that for conventional cultivation. The NB farmers, with a notably longer experience of no-till, judged the influence of direct drilling application on farm income clearly more optimistically because 83% of those surveyed gave a higher income and 17% a similar income.

The questioning of the experts, who judged that 34% of arable land in Europe, around 23 m ha, was suitable for the application of direct drilling (USA-NB 75% of farmland = 6 m ha) (*table 2*), as to whether there would be increased use by farmers of the system if there was more targeted advisory services available, greater availability of scientific results, financial support and/or suitable herbicide available, resulted in a negative answer from 23% of those surveyed. 72% of the 176 EU experts and 87% of the 50 NB experts are, on the other hand, of the opinion that with this sort of support , especially in the field of advisory services, there would be an increased application of direct drilling in agriculture.

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# Technical suitability of untreated vegetable oil as concrete parting agent

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## Keywords

Vegetable oil, concrete parting agent, parting effect,

*With unadulterated cold-pressed rapeseed oil used as a parting agent similarly good results are possible with concrete as where a conventional mineral oil based agent is used. This is especially so with non-absorbent shuttering. The main requirement here is the application of an as thin and even as possible film on the shuttering skin in order to avoid faults on the concrete surface. The use of an airmix plant has proved suitable in this aspect although this is more usually utilised in the manufacture of prefabricated concrete parts in production halls with electricity and compressed air supplies than out on the building site. The system offers a special advantage with respect to the greatly improved operator protection.*

Alongside input materials which are lost to the environment in technical use such as chain saw lubricant, concrete parting agents, for example, represent a great potential with an annual use of around 15 000 t. The majority of this parting agent lands directly in the environmental circulation. In the main, concrete parting agents are from a mineral oil basis. These products, most of which contain solvents, have a negative effect on humans and the environment. Parting agents consisting of vegetable oil, especially unadulterated vegetable oil, offer, where they have the correct technical suitability, a maximum level of environment and operator protection. Where cold-pressed oil from decentralised presses is possible, this could help environmental protection and increase income possibilities for agriculture. In practice the first promising experiences with concrete parting agents from home-produced vegetable oil have already been made. Precise investigations for exact results regarding a successful utilisation of untreated cold pressed oil have, however, not been carried out so far.

Thus, the target here was to investigate the technical suitability of unadulterated vegetable oil. To be investigated were the application characteristics of the vegetable oil and a suitable method for applying the parting agent film was to be developed. A further important aspect featured performance tests according to standardised methods with the manufacture and investigation of concrete sample cubes. With these, unadulterated vegetable oil was applied in a field test.

### Application

In the laboratory rapeseed oil application trials were carried out with different spray and sprinkle equipment. Featured were simple sprinkle equipment („cone sprays"), compressor sprays, an airless plant and an airmix spray plant (higher liquid pressure supported through air jetting).

Following preliminary trials, the airmix plant appeared the most applicable for the investigation. Using an automatic spray pistol on a precision-controlled sledge, the liquid flow, lateral distribution and separation film thickness was investigated with different jets, application distances, liquid and atomising air pressures with an application velocity of 0.5 m/s. For comparison purposes, trials were carried out with a hand-operated spray pistol with application velocities of 0.5 and 1.0 m/s.

The suitability of cold-pressed unadulterated rapeseed oil as a parting agent was investigated through special tests based on standardised procedures. These tests were based on information sheet „Parting agents for concrete, Part B: Tests" from the Deutschen Beton-Vereins e.V., the test standards DIN 1048, EN-196-1 as well as the Book 422 from the German committee for reinforced concrete DAfStb and the investigational report „Report 3: effect of parting agents on concrete surfaces" from the Verein Deutscher Betoningenieure.

### Sample cubes

Standardised steel forms (DIN 51 229) with inner measurements of 15•15•15 cm were used for the manufacture of sample cubes. In this form two elements out of absorbent wooden shuttering so fitted that they produce within the shuttering form neighbouring side planes at right angles to each other. In each case this resulted in two adjacent angles out of non-absorbent steel shuttering and of absorbent wooden shuttering. Applied as parting agents were cold-pressed rapeseed oil and a commonly-sold conventional product based on mineral oil. For the rapeseed oil, the parting agent was applied with the airmix plant Kremlin FLOWMAX 14.10 and MX hand pistol with a setting based upon one of the application trial results in order to produce an as thin as possible parting film. The mineral oil product was applied with a cloth (steel shuttering: wiping, wooden shuttering: dabbing).

For the investigations on the sample cubes, the applied shuttering material, the parting agents and their application rates as well as, for part of the work, the age of the parting agent were varied (*fig. 1*). A sprinkling system was used for applying the minimal amount of rapeseed oil (dose I) to steel, whilst with wooden shuttering two sprinkling operations with parting agent were carried out. With dose II, triple the amount was applied in each case through repeated sprinkling (3 and 6 times). With rapeseed oil and dose I a test was carried out with the parting agent aged by 24 hours in order to investigate how long the product remained effective. As a comparison, one application rate of the mineral oil product was investigated alongside for efficacy each on steel and wood. Characteristics on removal of the shuttering were investigated along with the appearance of the concrete surface and shuttering (colour, porosity, flouriness tendency of the concrete surface, the existence of residues on the surfaces of the concrete and the shuttering as well as the liability to damage or dampness), the parting effect after 24 hours, the surface tensile strength after 28 days, the adhesive strength (28 + 28 days) as well as the water absorbence capability after 21 days.

The investigations took place within the accredited laboratory of the company BAUTEST, Augsburg in cooperation with the Bavarian State Institute for Agricultural Technology, Weihenstephan.

In order to test the parting efficacy, sample cubes were produced from concrete in shuttering using the parting agents to be tested and taken out of the shuttering with removal equipment after 24 hours of storage according to a standardised procedure. As standard for the parting efficacy the resistance to concrete breaking was given in N/mm2. The surface tensile strength was determined from the adhesive-pull test according to DIN 1048 Part 2. This involves the sticking of a test stamp on the concrete surface and the determining, after 28 days, of the amount of effort required to tear this stamp free or cause damage to the concrete surface (N/mm2). For testing the adhesive strength between the concrete surface and subsequently-applied plaster, a standard mortar was applied as a sheet on the sample cube surface 28 days after manufacture. Just as in the tests of the separation efficacy, the

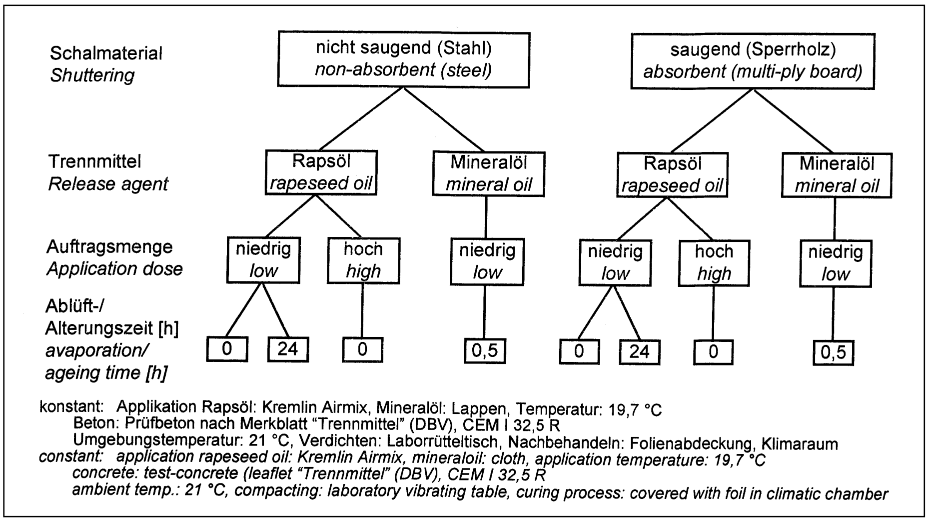


*Fig. 1: Experimental variants for producing concrete sample cubes*

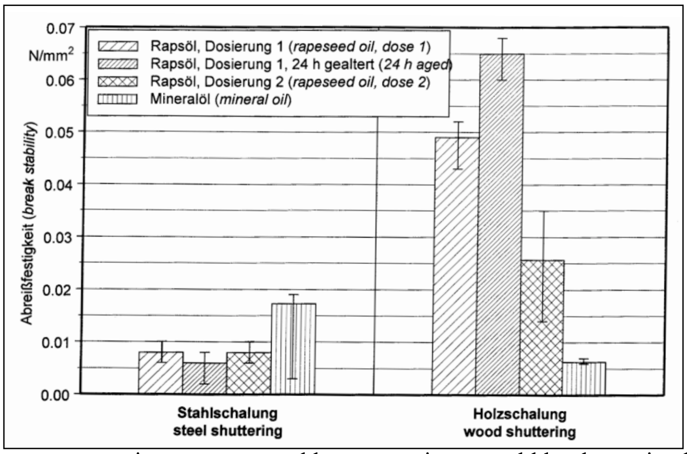


*Fig. 2: Releasing effects of natural rapeseed oil and a conventional parting agent (n=3)*

mortar covering was removed by appropriate equipment after a further 28 days. The testing for water absorbence was carried out by the water penetration tester from Dr.-Ing. Karsten. These testers were cemented to the concrete surface so that they were watertight. Water was then added. At regular periods the amount of water seeping through the concrete surface was recorded.

## Results and conclusions

From concrete work during first practical tests it was indicated that where rapeseed oil is used as parting agent it must be applied as a thin as possible film so that pores in the concrete surface are avoided. The investigations into the application characteristics of vegetable oils have indicated that, with simple sprinkling equipment, for instance cone jets or spray pistils for compressors, an especially thin parting agent film cannot be established because of the material's high viscosity. A fine atomisation with reduced liquid pressures (<10 bar) is therefore not possible.

The airmix plant showed itself as particularly suitable. With this it is possible, with medium liquid pressure (20 bar) and with adjustable air support, to apply an evenly-thin parting agent film on the shuttering with only very little fog production. In such cases, film thicknesses of around 10 µm are possible: a thickness which has proved efficient for good concrete quality. This application technique cannot, however, be applied straightforwardly on building sites currently because it requires supplies of electricity and compressed air. This equipment is absolutely suitable for use in prefabricated concrete production, however. In this case, an additional advantage is the higher operator safety offered.

*When removing*
the shuttering from the sample cube sides that have been produced by steel shuttering, no difference between the conventional parting agent and the unadulterated rapeseed oil could be determined.

Where the parting agent rapeseed oil was used on wooden shuttering, substantially more power had to be applied compared with for the mineral oil product. Fundamentally, where steel shuttering was used the surface of the concrete revealed less porosity compared with wooded shuttering. An optical difference between both parting agents with regard to the resultant surface condition unconnected with the application amounts, could not be determined. The only difference was that with mineral oil and steel shuttering a slightly higher tendency towards flouriness was determined.

*The parting*
efficacy was determined according to the power necessary to separate a standardised concrete body from the shuttering. *Figure 2* indicates the resistance to breaking of non-absorbent and of absorbent shuttering where both investigated parting agents were used with differing application rates. With all the rapeseed oil variants the parting efficacy on non-absorbent shuttering is, with a breaking resistance of under 0.01 N/mm$^2$, definitely better than with wood shuttering. This is not dependant on the application rate nor are different results given after a 24 hours ageing of the applied parting agent film. The non-absorbent shuttering also indicated advantages for rapeseed oil in comparison with conventional parting agents which, on the other hand, performed notably better when used with the absorbent wooden shuttering.

*The surface tensile strength*
between both shuttering variants is basically comparable. Nor could any substantial difference be determined between the types of parting agents. With 24-hour ageing of the parting agent film an improved stability (higher surface tensile strength) was apparent. The higher application rates of rapeseed oil on absorbent wooden shuttering showed disadvantages compared with the mineral oil product (*fig. 3*).

*The adhesive strength,*
i.e. the strength of the connection between the concrete body and the plaster, is especially high with the application of reduced rates of rapeseed oil or mineral oil on absorbent shuttering in comparison with steel shuttering. Again, here hardly any difference was apparent between the parting agents. The adhesive strength on wooden shuttering is about double that on steel shuttering. Higher application rates of rapeseed oil on the wooden shuttering led to a reduction in the adhesive strength to the value of that for steel shuttering.

*The water absorbence ability*
rose with the increase in porosity of the building components. There was little difference between the parting agents investigated. Conventional parting agent applied to steel shuttering led to a slightly higher water absorbence compared with the variant with rapeseed oil. When using wooden shuttering less water absorbence can be determined compared with steel shuttering.

In total, it can be concluded that unadulterated rapeseed oil has proved itself as a suitable concrete parting agent under the conditions investigated.

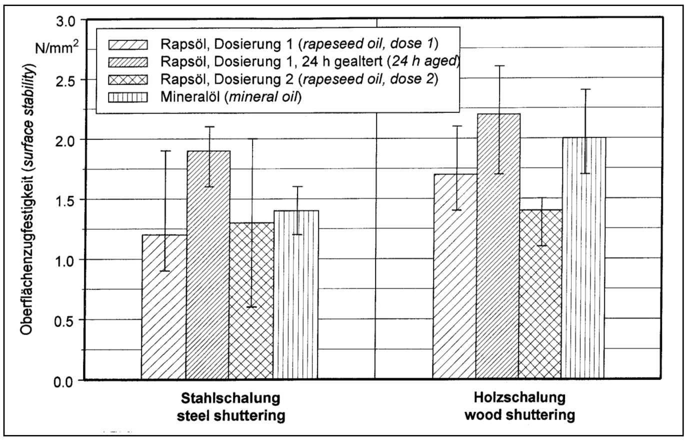


*Fig. 3: Surface stability of concrete cubes after 28 days with natural rapeseed oil and a conventional parting agent (n=3)*