

# Volatile Organic Chemicals

by Dick Evans

A significant change in the equipment in the sport of table tennis has occurred in recent years with the discovery of the enhanced performance of surface rubber attached, and re-attached, using speed glues. The International Table Tennis Federation has made a decision to conduct racquet testing to reveal the presence of Volatile Organic Chemicals (VOCs) emitting from these glues on the racquet. Additionally, testing instruments and procedures have been created to determine the presence of these VOCs, and rules setting limits on the permissible amount of these VOCs are now in place. (See ITTF Technical Leaflet T9)

What follows is a listing of results based upon a series of tests conducted by professional chemists with expertise in organic chemicals and gas chromatography.

## Test Objectives

To detect the presence, amount and duration of VOCs in a sample of glues commonly used by players in attaching racquet face sheets. To estimate VOC concentrations in comparison to ambient air.

## Methodology

Samples were tested from three glue types and one racquet spray cleaner using the FalconFAST GC chromatograph. Falcon is a company based in West Virginia that specializes in the detection of harmful materials in the air. Among other industries, Falcon and ABB work for the petroleum industry to protect workers in refineries from harmful levels of carcinogens. The FalconFast chromatograph is a gas testing instrument into which vapors from the test material are injected. It analyzes the compound and produces a computer generated chart (chromatogram) revealing volatility, boiling point, and diminishing values over time following subsequent tests.

The samples were placed inside the instrument which is capable of detecting and reporting parts per billion volume. Readings were taken at three separate points separated by two minute intervals in order to judge the rate of diminishment.

The two table tennis glues (one water based, and one classic chack) and the rubber cleaner that were a part of this test were all Butterfly products— all commonly used products, which are comparable to products offered by other manufacturers. (Likely the results would be very similar had we used other products of the same basic types that have been

sold by other manufacturers). We also tested a Universal Cement, a tire patch glue distributed by Advance Auto.

The Enez was not a part of this testing. The pass/fail threshold for the Enez machine as established by the ITTF was not shared with the testers, so the only question for this test was whether the samples would pose a health risk.

There is a 100 page booklet revised periodically by the American Conference of Government Industrial Hygienists titled Threshold Limit Values and Biological Exposure Indices which lists known VOCs with parts per million scores. Really harmful VOCs (I.E. carcinogens) do not have any numbers after their names because any amount of exposure is considered a danger to your health. Fortunately, no carcinogens were discovered in any of the glues, or spray, we tested. The tests described here were designed to test the materials themselves— not to test whole racquets. At least in theory, testing of a substance in its liquid form should result in a greater release of VOCs than testing a comparatively small amount of the same substance after application under the layered top sheet.

## Summary of Test Results

The tests on a sample of the old type of standard glue (Chack Fair) revealed significant VOCs (in the boiling point range of pentane to heptane) in concentration 10s to 100s parts per million. The tests on a sample of the new type of water based glue (Chack Free) revealed minimal VOCs (in concentrations approaching those levels found in ambient air). The tests on a sample of Universal Cement (tire patch glue) revealed significant VOCs (similar to the components and concentrations in the Chack Fair) that varied in concentration from 10s to 100s parts per million. The tests on a sample of rubber spray cleaner revealed very significant VOCs (wherein the first components had a low boiling [evaporation] point, and appeared to be butane). Generally speaking, concentrations below 1000 parts per million are not a concern to health for limited exposure. All of the samples (including the sample of ambient or background air that was present in the room before the tests began) contained some amount of VOCs. However, the tests revealed that none of the tested samples contained VOCs in excess of 1000 parts per million.

Distinct classes of samples were identified. The test was able to identify Chack Fair and Universal Cement as having similar components which appeared on the print-outs as a very similar series of peaks. Also, the ambient air sample and the Chack Free

samples appeared basically the same on their respective print outs. And finally, the volatile compounds contained in the rubber spray were clearly identifiable as a different class from both of the other two classes. These patterns could be used in the future via this process to help identify whether present VOCs are due to the application of glues or the application of a cleaner.

## Conclusions

At least two fairly clear conclusions can be drawn: First, the duration and concentration of VOCs from re-gluing, even with the two glues that had more significant levels of VOCs is of minimal hazard to humans (spectators or players) in an adequately ventilated venue. Second, as expected there are no VOCs present in water based glues (like the Chack Free sample tested). Also, more good news: the tests revealed evidence that VOCs dissipate very quickly, a greater than 50% reduction in the first two minutes, and another 50% reduction in the next two minutes. Note: there was no attempt to document the risks that may be associated with continued exposure to VOCs (even if each exposure is at relatively safe levels such as these).

## Comments From the Author:

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It may be useful to examine how other governing organizations have handled racquet testing policies in their countries. The task of implementing a testing protocol at the 2008 U.S. Nationals was considerable, including the creation of a random testing procedure, and the disturbance to the tournament schedule caused by pre-match testing. One potential solution would be to implement testing post-match. This, however, raises the question of whether a failed, post-match test results in the player being defaulted from that event— or perhaps the remainder of the tournament. Voluntary pre-match testing might prevent this sort of unfortunate event. However, wide-spread voluntary testing could be quite time consuming for the racquet testers. Fortunately, the final authority rests with the tournament referee, who, under such circumstances, must be both firm and fair.

It would be incumbent on the industry to develop and distribute only VOC-free glues for the sport. Industrial conversion to water-based glues should not be an overly difficult, or expensive, re-tooling.

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