

Extended Abstract—Computer Applications and Cleaning: Teas Fractional Solubility Parameter System in Conservation

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The solubility triangle is a useful tool to predict the effectiveness of a solvent or a solvent mixture in the elimination of a particular substance. A further advantage of this tool, as increased awareness of health issues for the restorer are becoming apparent, is the use of solubility parameters to substitute toxic solvents with less toxic ones.

This study carried out a comparative evaluation of three software applications that facilitate the use of the solubility triangle. The three computer programs are Triansol, Trisolv, and Solvent Solver. Using these applications, it was easy to find solvent mixtures that would be more effective in addressing a given problem. Moreover, they allow searching for equivalent or substitution solvents in a fast and comfortable way (Figure 1).

The Triansol software was created by Cremonesi and Bortolotti (1999) on the basis of some aspects of Feller's test (Feller, 1976). It can search solvents or solvent mixtures with certain solubility parameters fast and efficiently. It has a database of 27 solvents, but others can be added as required. In turn, the results are stored in another database. Of the three programs mentioned in this article, it is the only one that is not available free of charge through the Internet.

Trisolv (Figure 2) is an online working tool, created by Mauricio Coladonato and Paolo Scarpitti, and it can be accessed through the Web site of the Istituto Superiore per la Conservazione ed il Restauro (Coladonato and Scarpitti, n.d.). Its advantages include a display of different areas of solubility and the possibility of working in several languages.

The third program is Solvent Solver (Figure 3), created by Mark Ormsby (2006) in order to calculate mixtures of two or three solvents with particular solubility parameters. It also has the option of calculating the parameters of a mixture. Its biggest advantage is the accuracy of the mixing parameters and the stringency on the toxicity issue.

It cannot be denied that the solubility triangle offers only an approximation to the problem of predicting the behavior of solvent mixtures. There are 3-D models that are more accurate (Burke, 1984), but they are also far more difficult to use. Some critics are very harsh concerning the usefulness of the triangle (Stavroudis and Blank, 1989); although taking into account its obvious limitations, e.g., the results are not always very accurate, it can be of some use when designing solvent mixtures.

Each of the three programs has advantages and disadvantages. The best answer has been found by working with the three programs in combination. This results in an excellent approach to selecting the best solvent, or combination of them, for the particular problem to be addressed. Nonetheless, it can be said that the Triansol software is the most complete tool because it offers the possibility of obtaining reliable results in a quick

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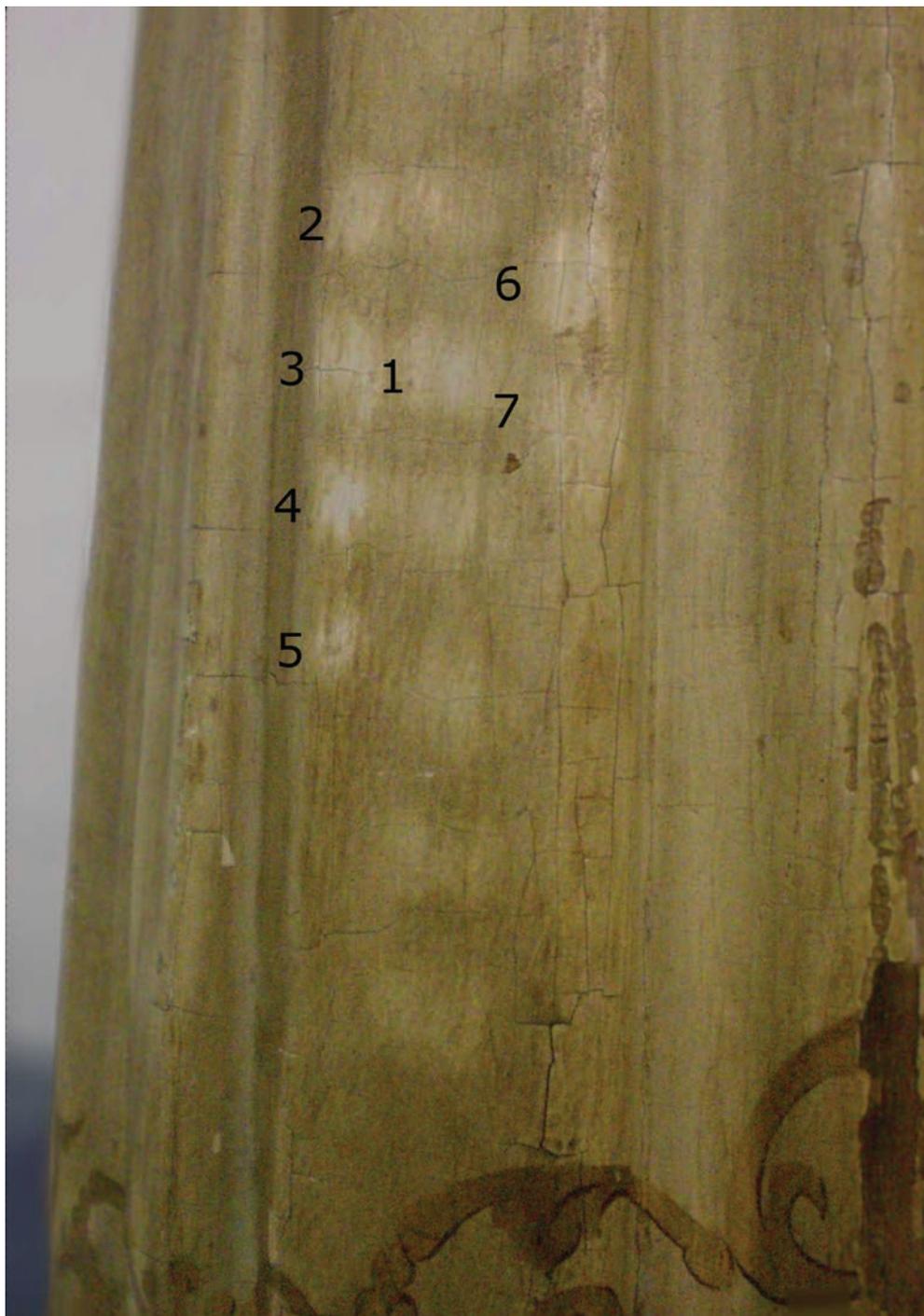


FIGURE 1. Different cleaning mixtures were tested on a polychrome sculpture, labeled 1 to 7 on the photograph. All mixtures had the same solubility parameters, i.e., $f_d = 64$, $f_p = 19$, and $f_h = 17$. The mixtures were as follows: 1, 50% acetone, 50% toluene; 2, 57% turpentine, 43% acetone; 3, 40% turpentine, 39% *n*-butylacetate, 21% acetone; 4, 51% acetone, 36% isooctane, 13% ethanol; 5, 53% 2-butanone, 29% nonane, 18% isopropyl alcohol; 6, 37% *n*-butyl acetate, 32% diethyl ketone, 31% turpentine; 7, 58% diethyl ketone, 42% dipentene. It can be seen that different mixtures with the same solubility parameter will not always be equally effective.

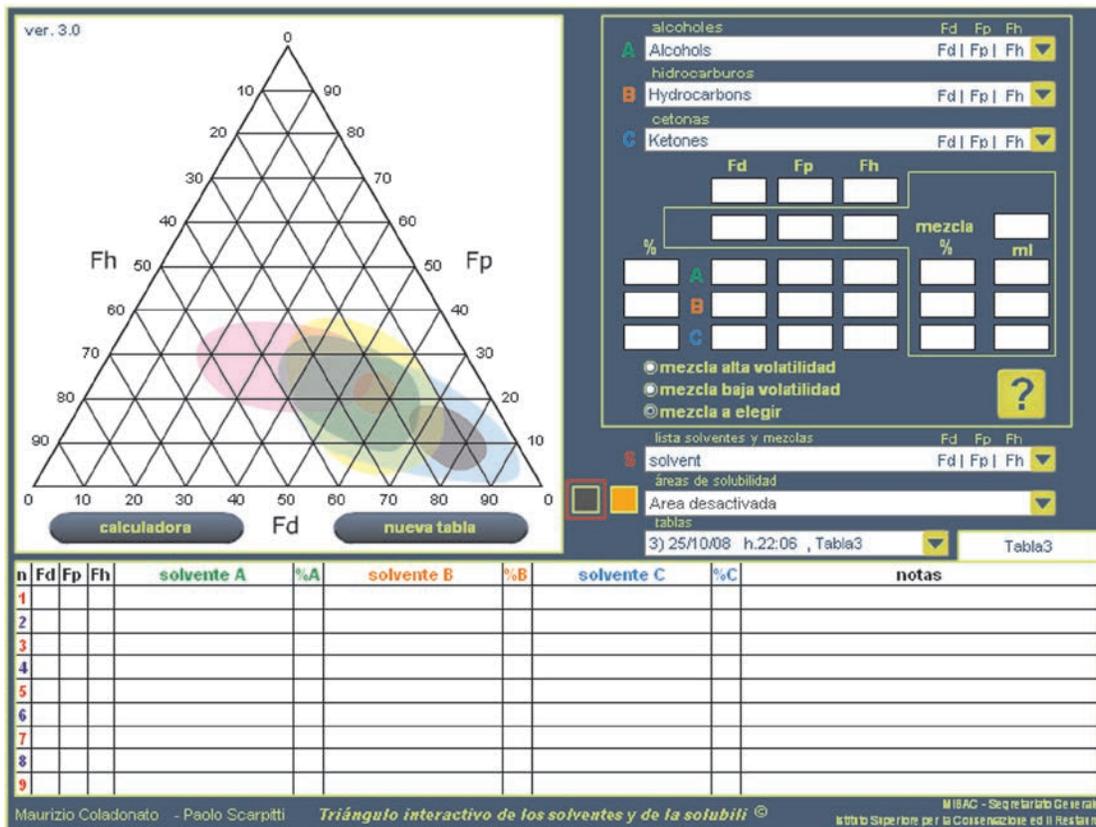


FIGURE 2. Trisolv software main window.

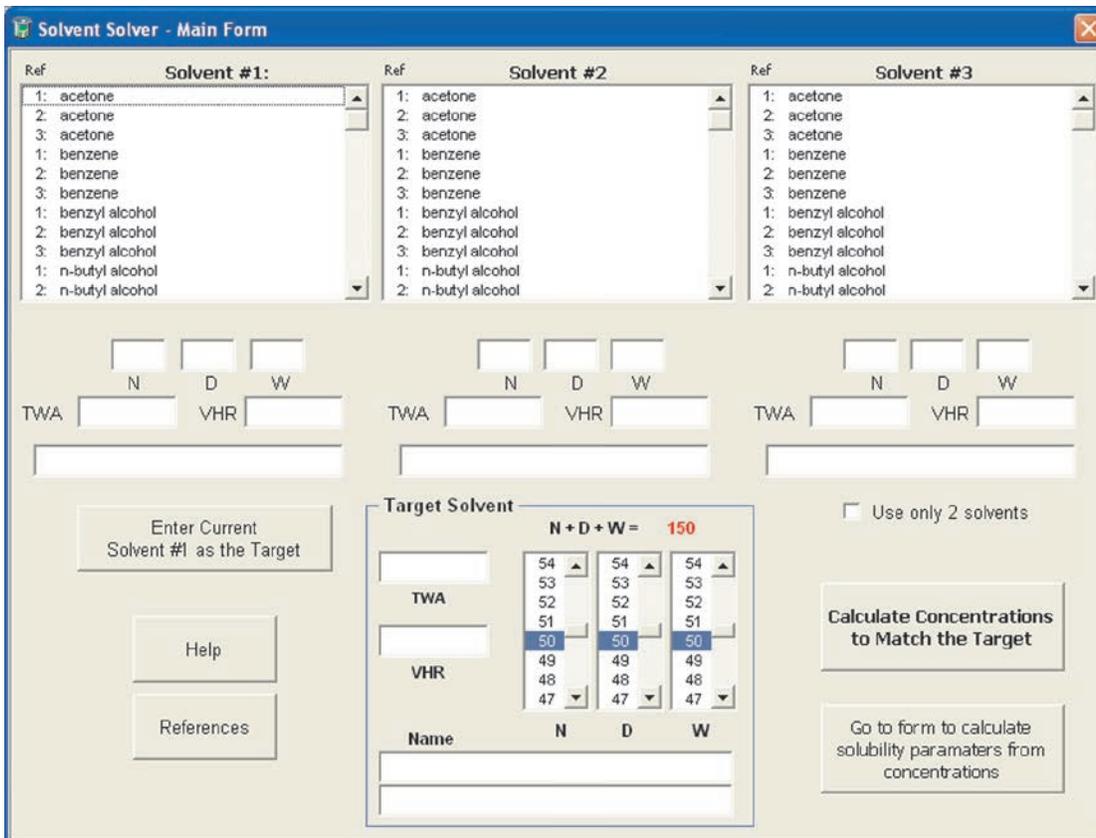


FIGURE 3. Solvent Solver software main window.

and easy way as well as the ability to store them in a database. This decision is also supported by the fact that new solvents can be added to the database and that, having the largest number of solvents, it offers far more variability in the mixtures that can be created.

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