



TECHNICAL NOTE 2-99R

Making Sense of OC Strengths

Used in Less-Lethal Weapons and Defense Sprays

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Introduction

Hydro-Force has fielded many questions regarding the strengths of pepper sprays. Inquiries have referred to Scoville Heat Units as well as percentages of Oleoresin. We have developed this technical note to provide information and clarify some of the confusion about relative strengths of pepper sprays. We invite your comments and additional information you may have in the hope that everyone becomes more educated in the formulation and use of pepper spray.

Summary

There appears to be great variations in the amount of capsaicin in the different pepper spray device manufacturers' products, with no published law enforcement standards other than that found in California. Capsaicin is the active ingredient in Oleoresin Capsicum, generally known as OC, or pepper spray, and there are very precise analytical methods for determining the amount of capsaicin in any OC or pepper spray. Our research has shown that:

1. The Capsaicin in any pepper spray mixture should be measured using an approved scientific method and should be stated as a percentage in accordance with the requirement published by the California Department of Justice.
2. Customers should require a statement of chemical analysis with each pepper spray accurately showing the percentage of Capsaicins by weight present in that container.
3. The product label should show the percentage level of Capsaicins present in the container as well as all other ingredients.
4. The Oleoresin Capsicum used in the preparation of any pepper spray mixture should be a food grade product approved by the Food and Drug Administration (FDA).

Hydro-Force will continue to compile historical information on measurements and strengths of pepper sprays. We welcome any additional information. New information may be incorporated in future technical notes.

Background

The information in this technical note was originally developed for our employees, sales associates and a few customers who asked questions regarding the relative strengths and formulation of pepper spray compounds. Since researching this information, we have found that many other customers are interested in this type of information. In most cases, the information presented herein has been taken from the published papers and data from other individuals and companies. We have provided a footnote listing of these references for your information. We cannot, however, guarantee the accuracy of the information taken from those documents. Each is available to you upon request.

History

There seems to be a great deal of variation in the amount of Capsaicin in any particular pepper spray container. We are trying to make sense out of the information and compare the amount with the amount used in the products we represent as well as others. In this regard, we have examined information from the following sources:

California Department of Justice
American Spice Trade Association (ASTA)
Kalsec, Inc.
Defense Technologies Corp.
Zarc International (Manfs. of Cap-Stun)
Israel Product Engineering (ISPRA)
Hydro-Force, Inc.

Findings

1. The California Department of Justice provides the only document we have found to date that defines the acceptable percentage range for Capsaicin contained in pepper spray devices. The California Department of Justice states that the permissible range of Capsaicin in a hand-held aerosol device used for law enforcement can be within the range of .20% to .90%. (1)
2. The American Spice Trade Association (ASTA) is an organization that oversees testing and standards for spices and related compounds. ASTA information states that the most accurate method of measuring the amount of Capsaicin in a solution is using the High Performance Liquid Chromatography (HPLC) method 21.3. (2) HPLC is a generally accepted scientific method of determining the chemical composition of complex compounds. The American Association of Analytical Chemists (AOAC) has a similar testing standard 995.03. HPLC testing requires an established

test procedure, specialized testing equipment and laboratory conditions. Either HPLC testing method provides the results as a percentage.

3. Another method most often used in the food industry is Scoville Heat Units (SHU). SHU testing relies on a panel of trained human taste testers. Each panel member tastes a food sample that has been diluted to a level that allows the taster to just detect (or taste) the OC. The amount of the dilution becomes the value in Scoville Heat Units. For example, if an OC sample has been diluted to 1 part in 1 million when verified by the panel of tasters, the Scoville heat value becomes 1,000,000 SHU.
4. There is no direct method we have found for converting between HPLC percentage measurements and SHU values. However information from various manufacturers indicates that, in general, the %MC Capsaicin measured by the HPLC method is comparable to the Scoville Heat Units (SHU) method as 1% MC equals 150,000 SHU.

Therefore, If a manufacturer states that their solution is 100, 000 SHU the HPLC value in general will be $100,000/150,000 = .66\%$ MC. It generally appears that each 1% of Capsaicin yields about 250,000 SHU.

5. One defense spray manufacturer, Defense Technologies, states that they utilize the water soluble OC from Kalsec at 500,000 SHU. (4) This seems to compare with their other information in which they say that they utilize a .2% capsaicinoid level (4) in their defense spray products. Their Material Safety Data Sheet (MSDS) shows that each unit contains 10% OC (5). 500,000 SHU equals 2% MC, x 10% equals .2% OC. Please note that the terms Capsaicinoid, Capsaicin, and OC are often used interchangeably.
6. Another defense spray manufacturer, Zarc International, manufacturers of Cap-Stun, takes a different approach. They claim that their Capsaicin level is .92% and their OC% is 5.5%(6). A .92% level is greater than the California maximum of .9% but they apparently are approved for sale in CA. If we use the same math as for Defense Technologies, the base OC material would have to be $.92\%/0.055 = 16.73\%$, which would mean a SHU value of the Capsaicin used in manufacturing the Zarc products is approximately 2,500,000.
7. Israel Product Research (ISPRA), an Israel-based product manufacturer, uses an oil-based OC with an approximate Capsaicin amount of 9%(7) although their book states 5% by weight (8) similar to Cap-Stun. They have utilized Methylene Chloride, a suspected carcinogen, in some manufactured units. They have developed a water-soluble base (containing no Methylene Chloride). The chemical information for this unit lists a 9% solution (although the calculation shows 10%) but it appears that they are using more like a .6% (10% of 1,500,000 SHU = 6% MC/10= .6%)(10) Capsaicin percentage.

8. We have found much discussion about the solvent used with the Capsaicin in the pepper spray mixture. Defense Technologies uses a Propylene Glycol and Denatured Alcohol while Cap-Stun touts Isopropyl Alcohol. There seems to be little practical difference as long as there are no separate health problems caused by the solvent. All other manufacturers criticize the use of Methylene Chloride.
9. The Hydro-Force, Inc. Water Restraint System directly injects 2% MC Capsaicin directly into the water stream at a rate of less than 8%, which provides a Capsaicin level of less than .16%. The Capsaicin is injected into a substantial amount of water, only a small portion of which will strike the target individual (s). The low percentage of injected OC has been very successful over the past 15 months of operation even though the amount is much lower than the minimum amount allowed by the California DOJ for law enforcement use. A certified chemical assay is provided with each chemical delivery.
10. The Hydro-Force, Inc. X-10 OC Extension Device utilizes a water-based solution that is very similar to handheld aerosol sprays. The X-10 has been designed to limit the amount of OC released to approximately 6 grams per spray. The chemicals have been selected to project a Capsaicin level of .6%, the approximate midpoint of the California DOJ allowable range. A certified chemical assay is provided with each chemical delivery.
11. All the pepper spray devices we have investigated, both in person and on the Internet, state the percentage of "pepper spray" contained in the solution. However, this always appears to be the percentage of the OC solution used to make the compound and has no reference to the amount of Capsaicin contained on the compound. For example, if manufacturer 1 states 10% OC and uses a 2% Capsaicin material (approx. 500,000 SHU), the Capsaicin percentage will be .2%. Manufacturer 2 using 10% OC and using a 6% Capsaicin material (approx. 1,500,000 SHU) will have a Capsaicin percentage of .6%, about 3 times the Capsaicin strength of manufacturer 1. This Capsaicin percentage information is not included on most Material Safety Data Sheets (MSDS).
12. It appears that most OC produced today is manufactured for food additive purposes. In order to be used as a food additive, the material must qualify under separate rules established by the Food and Drug Administration. We believe that OC meeting food standards is better for everyone since it will contain no compounds harmful to humans. Therefore, we recommend that all OC used in less lethal devices or defense sprays be of food grade quality.

Recommendations

1. All manufacturers of products or systems should be required to state the percentage Capsaicin in the overall compound, as well as the percentage of OC. This percentage will allow direct comparisons between the chemical strengths provided by all manufacturers.
2. All manufacturers of products or systems should be required to provide an assay report with deliveries of any OC chemical products. A recognized laboratory that has performed the HPLC testing and is capable of providing the report should prepare the assay report

References

- (1) Page 2 from CA DOJ rules on hand-held aerosol tear gas weapons containing OC
- (2) ASTA letter dated 6/19/99
- (3) Kalsec technical data sheet
- (4) Page from Defense Technology brochure dated 2/95
- (5) MSDS from Defense Technology
- (6) Four Pages from Cap-Stun booklet copyright 1993-1996
- (7) MSDS from Advanced Materials for ISPRA, oil based chemical
- (8) Page from ISPRA Model 5 booklet, oil based chemical
- (9) MSDS from Advanced Materials for ISPRA, water based chemical
- (10) MSDS from Advanced Materials for ISPRA, water based chemical (no form)

f/n: Technical Note 02-99R