Guidance for Operators of Ultraviolet (UV) systems

The following is taken from the Juice Hazards Guide

5.32 UV Processing Systems

UV systems for treating juice have recently begun to be commercialized. FDA approval in 2000 of UV radiation to treat juice to reduce human pathogens in (21 CFR 179.39) requires that the UV radiation be provided by low pressure mercury lamps emitting 90 percent of the emission at a wavelength of 253.7 nanometers (2,537 Angstroms), and that during the treatment, the juice undergo turbulent flow through tubes with a minimum Reynolds number of 2,200. If you are considering using UV radiation to process your juice, you should confirm with your process authority that the system you are considering meets the requirements of 21 CFR 179.39.

We also recommend that you consider the following questions in consultation with your process authority:

- Have you identified the appropriate pathogen as the "pertinent microorganism" considering that UV radiation is the means of treatment for achieving the 5-log pathogen reduction? For instance, if you are processing apple juice, you need to know whether *E. coli* O157:H7, *Crytopsporidium parvum*, or some other pathogen is more resistant to UV radiation to determine which of these is the pertinent microorganism. The relative resistance of pathogens to UV radiation may not be the same as it is for thermal treatment.

- Has the UV system been validated to achieve effectively a 5-log pathogen reduction for the "pertinent microorganism" (see previous bullet) in the juice that you will be processing? The effectiveness of given UV treatment conditions can vary from one juice to another due to factors such as the opacity of the juice. The treatment parameters, e.g., flow rate, UV energy level, needed to achieve a 5-log pathogen reduction, may vary from one juice to another juice. We recommend that you consult with your process authority to ensure yourself that the system and processing parameters you will use have been validated to achieve a 5-log pathogen reduction in your juice.

- What are the critical limits for the process? Is the flow rate of the juice through the UV exposure chamber critical to the effectiveness of the process? Is the delivery of a minimum level of UV energy critical to the process? If so what are the critical flow rate and UV energy parameters? You need to know what the critical limits are to be able to enter them into your HACCP plan.

- What monitoring procedures will you have to carry out to ensure that the critical limits are met? Is it necessary to monitor flow rate continuously, or does the design of the equipment regulate the flow rate to not exceed the critical limit? What monitoring procedure, e.g., UV sensors, will indicate that the juice continually receives the critical level of UV energy? Is the system designed to shut down if a sensor fails or if a sensor indicates that a critical limit is not being met?

- What verification procedures will you have to carry out? These may include checking the UV sensors periodically to ensure that they are operating properly (FDA requires light tubes be tested every three years).
- What cleaning procedures should be carried out between runs to ensure that residues, e.g., particulates, do not accumulate in the equipment that would reduce the effectiveness of the treatment?
- What corrective action procedures will you specify in your HACCP plan? Your corrective action procedures should ensure that if the system fails, e.g., due to failure of a UV lamp, any juice that may not have received the 5-log pathogen reduction is segregated and, if necessary, treated again to ensure a 5-log reduction, and that the failed lamp is replaced.