November 19, 2007

Unitized Group Ration – Express (UGR-E) Retorted Polymeric Food Tray Heating Performance Test Results

Introduction: Several UGR-E test sample polymeric food trays were observed to have bent flanges. The flanges (Figures 1-4 below) were obviously bent after sealing and occurred during the retort process, likely from inadequate tray racking procedures. Although this doesn't appear to be an issue with current polymeric tray production, it was decided to test these trays to determine whether the bent flanges could negatively impact heating performance of the UGR-E. The theory is that bent flange(s) may have the potential to raise the polymeric food tray up off the edge of the plastic UGR-E heating tray. This additional spacing could contribute to reduced heating performance, since the spacing beneath the tray will be increased. This additional spacing could increase the gap between the food tray and the chemical heater, which in turn could reduce the conduction of heat to the food tray, as the area in direct contact with the heater will be decreased. Testing was conducted to assess the potential performance impact this issue poses to the UGR-E application.

Figures 1-4 - Examples of Tray Flange Bending During Retort Process

Figure 1. Poly Tray Bent Flange (Edge)

Figure 2. Poly Tray Bent Flange (Corner)

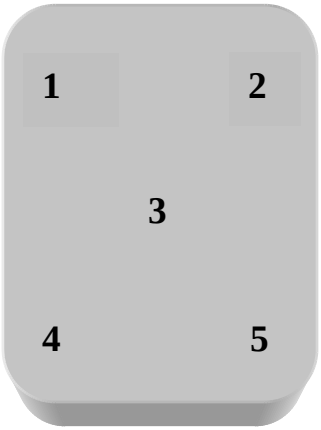
Figure 3. Poly Tray Bent Flange (Side)

Figure 4. Poly Tray / Heater Tray Offset

Test Procedure:

A standard UGR-E assembly, consisting of four food tray samples, four standard UGR- E heating trays and four saline water activated chemical heaters was configured and cooled to approximately 40ºF immediately prior to the test. Each of the four heaters was activated with 330ml of 1.5% saline solution. The assembly was closed and placed on a ½" foam pad. Once activated, the assembly was allowed to heat for 45 minutes. After the 45 minute heating period, the temperature of the food trays was examined with a calibrated digital handheld thermometer in 5 different locations, as depicted in Figure 5, to provide representative data on food temperature within the trays. The thermometer was pushed through the sealed lid-stock on the top of the food trays and was swirled around in the foodstuffs contained within to ensure that a more reliable, reproducible reading was obtained.

Figure 5 – Location Points of Temperature Readings Taken in Polymeric Food Trays



Results:

Part 1 – Heating performance of a four polymeric food tray UGR-E assembly (test):

Temperature readings are presented below in Table 1 for all 4 trays and at all 5 points in each tray. Tray 1 was located in the top position of the UGR-E module, and tray 4 was located at the bottom with trays 2 and 3 in ascending order from top to bottom. Trays 3 and 4 exhibited insufficient heating, which is clearly attributed to the significant offset gap created by the bent food tray edges. The degree of flange bend did not change during or after heating. Trays 2, 3 and 4 all consisted of Chicken Breast in Gravy, while tray 1 consisted of Walnut Tea Cake. All trays were conditioned to 38°F prior to the test.

Table 1 – Test Tray Temperatures after 45 Minutes (°F)

	Tray 1	**Tray 2**	**Tray 3**	**Tray 4**
Location 1	120.6	151.6	134.9	119.3
Location 2	126.4	151.8	139.6	125.4
Location 3	112.9	145.5	122.5	113.3
Location 4	124.6	145.7	122.5	117.3
Location 5	128.4	153.0	138.5	125.6
Average delta	**122.6**	**149.5**	**131.6**	**120.2**

Part 2 – Heating Performance of a four polymeric food tray UGR-E assembly (control):

Temperature readings are presented below in Table 2 for all 4 trays taken at the same 5 points depicted in Figure 5 for each tray. Trays 1-4 were positioned the same as in Part 1 above. The average temperature of the bottom 3 trays ranged from 146.5 to 155.7 F, with a top tray temperature of 116.7. Flanges of these four trays exhibited no bend and did not change during or after heating. Similar to Part 1, Trays 2, 3 and 4 consisted of Chicken Breast in Gravy and tray 1 consisted of Walnut Tea Cake. All components were conditioned to 38°F prior to the test.

Table 2 – Control Tray Temperatures after 45 Minutes (°F)

	Tray 1	**Tray 2**	**Tray 3**	**Tray 4**
Location 1	120.7	156.1	137.1	141.2
Location 2	115.1	152.6	136.1	129.9
Location 3	112.8	156.3	152.0	141.6
Location 4	118.0	158.7	166.2	159.8
Location 5	117.1	154.9	162.5	159.8
Average delta	**116.7**	**155.7**	**150.8**	**146.5**

Table 3 highlights the reduced heating performance observed with the test vs. control food trays, as follows:

Table 3 – Heating Performance Temperature Difference after 45 Minutes (°F)

	Tray 1	**Tray 2**	**Tray 3**	**Tray 4**
Location 1	-0.1	-4.5	-2.2	-21.9
Location 2	11.3	-0.8	3.5	-4.5
Location 3	0.1	-10.8	-29.5	-28.3
Location 4	6.6	-13	-43.7	-42.5
Location 5	11.3	-1.9	-24	-34.2
Average Delta	5.8	-6.2	-19.2	-26.3

Conclusions:

The heating performance of the test sample polymeric food trays exhibiting bent flanges was found to be notably reduced compared to control polymeric trays exhibiting no bent flanges. Based on the examination of the individual trays, as tested in the four tray UGR-E assembly, it appears that the additional gap between the bottom of the food trays and their adjacent saline activated chemical heaters, as caused by the bent flanges, is what resulted in the drop-off of heating performance. As such, it is important for UGR-E assemblers to only utilize polymeric trays with flat flanges in the assembly process, in order to maintain consistent, acceptable UGR-E heating performance.

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