(29) HIGH EFFICIENCY CHECKER SHAPES

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The effect of high efficiency checker shapes on stove performance is considered using fundamental thermodynamics and a comparison is made between the high efficiency checkers and standard checkers.

The thermodynamics of the stove checkerwork system can be expressed by two differential equations: $MC\,(\partial T/\partial t) = hA(\Theta - T)$ and $mc\,(\partial \Theta/\partial t) = WLc\,(\partial \Theta/\partial x) - hA(\Theta - T)$. These equations describe the performance of a stove, provided the proper values for parameters are chosen. M, mass of checkerwork; h, heat-transfer coefficient; and A, heating surface area in the stove are functions of checker brick shape. Hence, stove thermal output can be increased most economically by selecting checkerwork systems which will utilize these parameters most efficiently.

A comparison of checkers shows that mass of checkerwork per unit volume is relatively independent of checker shape; hence, M, can be considered constant. This mass is a measure of the stove's ability to store heat. The most effective checker brick mass can be obtained only if there is a constant temperature throughout the checker wall. A checker that has a high percentage of its total mass closer to the heating surface and has thin walls will approach these conditions. High efficiency checker shapes concentrate a higher percentage of mass closer to the heating surface, utilizing the total mass available more effectively than standard checkers.

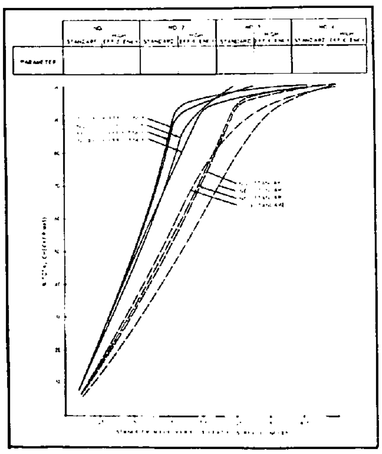
The heat-transfer coefficient, h, and the heating surface area, A, are dependent on checker flue geometry. High efficiency checkers increase the heating surface area markedly - approximately 50%. The heat-transfer coefficient, h, is increased through the use of checkers with small hydraulic diameter flues and high flue velocities. Since h and A appear as products, the thermal output from a given stove will be greatest with high efficiency checkers. (See figure)

Probably the three most frequently voiced objections to the use of these checkers are:

1. Probability of deformation is greater due to thinner walls. However, a sufficient number of stoves using these checkers verify that deformation in the walls is no greater than in standard checkers.

2. Initial pressure loss will be higher than with standard checkers due to smaller flues. -- But it can be shown that this will cause an increase in the apparent convective heat transfer coefficient and, thus, this may not be an objection but an advantage.

3. Faster plugging or fouling, due to smaller flues. -- Plants realize the importance of gas cleanliness even for standard checker linings and have taken steps to improve this. This, coupled with installation of independent furnace backdrafting systems shows that the amount of contamination is declining.



% MASS VS. DISTANCE FROM HEATING SURFACE