Coke ovens—problems and construction

R. J. SLINN

Mr H. A. G. Tattersill, M

What is the magnitude and distribution of expansion forces on the end buttresses of coke oven batteries?

40. The ram machine exerts a considerable force to overcome friction of coke in the ovens when commencing discharge into the coke car. This force is transmitted through the ovens to the supporting raft. What is the magnitude and distribution of this force?

41. The concrete buttresses and raft have primarily to withstand dead and live loads, and the effect of temperatures directly at the skin of the concrete can be calculated. However, are these temperatures of such a magnitude as to reduce permanently the inherent strength of Portland cement concrete made with either ordinary or special aggregates?

42. I note the height of a service bunker of 2500 tons coal capacity is stated as 140 m. Assume the height of the ovens plus charging car (i.e. to underside of hoppers) is in the order of 25 m and that the bunker is surmounted by a conveyor housing and perhaps a water supply reservoir having a combined total height of say 10 m. This leaves a coal storage depth of about 100 m and would result in a plan area equal to the width of the ovens by a length in the order of 5 m. Apart from the enormous compression of the coal and unit pressure thereof on the hoppers, are such proportions economical? Further, the higher the bunker the longer the conveyor from the coal storage station and crushery. In my experience, a bunker of even 4000 tons capacity has not been more than 80 m in total height.

Mr Slinn

Mr Tattersill has raised some of the most pertinent problems experienced in the design of a coke oven battery. However, the Paper was not intended to deal with such design problems.

44. Expansion forces in coke oven batteries, particularly those experienced on starting up the battery, vary considerably with the particular manufacturer's design, size of oven and carbonizing time, but generally it is normal for the longitudinal expansion of the refractory brickwork to be absorbed with expansion joints in the brickwork at each oven centre line, thus avoiding accumulative expansion passing to the buttress. The loading on the buttresses is therefore that resulting from

(*a*) the expansion of the insulating and backing brickwork from the end heating flue wall to the buttress face (this is usually assumed to act uniformly over the buttress face and has an order of magnitude of about 1000 lb/sq. ft)

(*b*) the small thrust at the nozzle deck level due to the expansion in the nozzle deck slab (with modern construction this is eliminated by the use of special sliding joints to remove the load from the buttress wall); additional expansion joints are placed along the nozzle deck slab to limit the accumulative effect of expansion.

45. The magnitude and distribution of the forces exerted when an oven is pushed has been the subject of several papers and while opinions vary quite widely, few authors have produced conclusive evidence to support their figures. However, it is generally considered that this pushing force is absorbed by the mass of the refractory brickwork,

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which is in turn restrained by the buckstays. The tension on the buckstays is maintained by springs and is ostensibly to keep the refractory brickwork tight and no increased loading on these springs is observed when an oven is pushed. The normal loads on the buckstays are transmitted to the nozzle deck edge beams using steel tie rods laid in steel tubes in the nozzle deck and for large ovens a magnitude of these compressive forces is usually of the order of 8–9 tons per rod.

46. The temperatures which may be expected at the upper skin of the nozzle deck are never much in excess of 70–80°C on a new battery, deteriorating over a 20 year life to approximately 120°C. The quality of the insulation material currently used is such that damage to the nozzle deck concrete is rare. In fact, it is common for a nozzle deck to have a battery rebuilt after 20 years life and serve at least a further 20 years with only minimal remedial work.

47. The service bunker is approximately 140 ft and not 140 m high, being made up briefly of 50 ft from ground level to oven top, 30 ft from oven top to bunker bottom and 60 ft of net bunker capacity.