

**BULLETIN NO. 18. A
STUDY OF
SAND-LIME BRICK**

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Bulletin No. 18. A Study of Sand-Lime Brick by S. W. Parr & T. R. Ernest

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S. W. PARR & T. R. ERNEST

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SAND-LIME BRICK**

J.C. Branner. et.

ILLINOIS
STATE GEOLOGICAL SURVEY

F. W. DEWOLF, Director

BULLETIN No. 18

A Study of Sand-Lime Brick

BY

S. W. PARR

AND

T. R. ERNEST



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1. 设 $f(x) = x^2 + 2x + 1$, $g(x) = x^2 - 2x + 1$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 2x + 1) + (x^2 - 2x + 1) = 2x^2 + 2$
 $f(x) - g(x) = (x^2 + 2x + 1) - (x^2 - 2x + 1) = 4x$

2. 设 $f(x) = x^2 + 3x + 2$, $g(x) = x^2 - 4x + 5$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 3x + 2) + (x^2 - 4x + 5) = 2x^2 - x + 7$
 $f(x) - g(x) = (x^2 + 3x + 2) - (x^2 - 4x + 5) = 7x - 3$

3. 设 $f(x) = x^2 + 5x + 6$, $g(x) = x^2 - 3x + 4$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 5x + 6) + (x^2 - 3x + 4) = 2x^2 + 2x + 10$
 $f(x) - g(x) = (x^2 + 5x + 6) - (x^2 - 3x + 4) = 8x + 2$

4. 设 $f(x) = x^2 + 7x + 10$, $g(x) = x^2 - 5x + 8$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 7x + 10) + (x^2 - 5x + 8) = 2x^2 + 2x + 18$
 $f(x) - g(x) = (x^2 + 7x + 10) - (x^2 - 5x + 8) = 12x + 2$

5. 设 $f(x) = x^2 + 9x + 14$, $g(x) = x^2 - 7x + 12$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 9x + 14) + (x^2 - 7x + 12) = 2x^2 + 2x + 26$
 $f(x) - g(x) = (x^2 + 9x + 14) - (x^2 - 7x + 12) = 16x + 2$

6. 设 $f(x) = x^2 + 11x + 18$, $g(x) = x^2 - 9x + 16$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 11x + 18) + (x^2 - 9x + 16) = 2x^2 + 2x + 34$
 $f(x) - g(x) = (x^2 + 11x + 18) - (x^2 - 9x + 16) = 20x + 2$

7. 设 $f(x) = x^2 + 13x + 24$, $g(x) = x^2 - 11x + 20$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 13x + 24) + (x^2 - 11x + 20) = 2x^2 + 2x + 44$
 $f(x) - g(x) = (x^2 + 13x + 24) - (x^2 - 11x + 20) = 24x + 4$

8. 设 $f(x) = x^2 + 15x + 30$, $g(x) = x^2 - 13x + 24$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 15x + 30) + (x^2 - 13x + 24) = 2x^2 + 2x + 54$
 $f(x) - g(x) = (x^2 + 15x + 30) - (x^2 - 13x + 24) = 28x + 6$

9. 设 $f(x) = x^2 + 17x + 42$, $g(x) = x^2 - 15x + 28$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 17x + 42) + (x^2 - 15x + 28) = 2x^2 + 2x + 70$
 $f(x) - g(x) = (x^2 + 17x + 42) - (x^2 - 15x + 28) = 32x + 14$

10. 设 $f(x) = x^2 + 19x + 50$, $g(x) = x^2 - 17x + 32$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 19x + 50) + (x^2 - 17x + 32) = 2x^2 + 2x + 82$
 $f(x) - g(x) = (x^2 + 19x + 50) - (x^2 - 17x + 32) = 36x + 18$

11. 设 $f(x) = x^2 + 21x + 60$, $g(x) = x^2 - 19x + 36$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 21x + 60) + (x^2 - 19x + 36) = 2x^2 + 2x + 96$
 $f(x) - g(x) = (x^2 + 21x + 60) - (x^2 - 19x + 36) = 40x + 24$

12. 设 $f(x) = x^2 + 23x + 70$, $g(x) = x^2 - 21x + 40$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 23x + 70) + (x^2 - 21x + 40) = 2x^2 + 2x + 110$
 $f(x) - g(x) = (x^2 + 23x + 70) - (x^2 - 21x + 40) = 44x + 30$

13. 设 $f(x) = x^2 + 25x + 80$, $g(x) = x^2 - 23x + 48$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 25x + 80) + (x^2 - 23x + 48) = 2x^2 + 2x + 128$
 $f(x) - g(x) = (x^2 + 25x + 80) - (x^2 - 23x + 48) = 48x + 32$

14. 设 $f(x) = x^2 + 27x + 90$, $g(x) = x^2 - 25x + 56$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 27x + 90) + (x^2 - 25x + 56) = 2x^2 + 2x + 146$
 $f(x) - g(x) = (x^2 + 27x + 90) - (x^2 - 25x + 56) = 52x + 34$

15. 设 $f(x) = x^2 + 29x + 100$, $g(x) = x^2 - 27x + 64$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 29x + 100) + (x^2 - 27x + 64) = 2x^2 + 2x + 164$
 $f(x) - g(x) = (x^2 + 29x + 100) - (x^2 - 27x + 64) = 56x + 36$

16. 设 $f(x) = x^2 + 31x + 110$, $g(x) = x^2 - 29x + 72$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 31x + 110) + (x^2 - 29x + 72) = 2x^2 + 2x + 182$
 $f(x) - g(x) = (x^2 + 31x + 110) - (x^2 - 29x + 72) = 60x + 38$

17. 设 $f(x) = x^2 + 33x + 120$, $g(x) = x^2 - 31x + 80$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 33x + 120) + (x^2 - 31x + 80) = 2x^2 + 2x + 200$
 $f(x) - g(x) = (x^2 + 33x + 120) - (x^2 - 31x + 80) = 64x + 40$

18. 设 $f(x) = x^2 + 35x + 130$, $g(x) = x^2 - 33x + 88$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 35x + 130) + (x^2 - 33x + 88) = 2x^2 + 2x + 218$
 $f(x) - g(x) = (x^2 + 35x + 130) - (x^2 - 33x + 88) = 68x + 42$

19. 设 $f(x) = x^2 + 37x + 140$, $g(x) = x^2 - 35x + 96$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 37x + 140) + (x^2 - 35x + 96) = 2x^2 + 2x + 236$
 $f(x) - g(x) = (x^2 + 37x + 140) - (x^2 - 35x + 96) = 72x + 44$

20. 设 $f(x) = x^2 + 39x + 150$, $g(x) = x^2 - 37x + 104$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 39x + 150) + (x^2 - 37x + 104) = 2x^2 + 2x + 254$
 $f(x) - g(x) = (x^2 + 39x + 150) - (x^2 - 37x + 104) = 76x + 46$

21. 设 $f(x) = x^2 + 41x + 160$, $g(x) = x^2 - 39x + 112$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 41x + 160) + (x^2 - 39x + 112) = 2x^2 + 2x + 272$
 $f(x) - g(x) = (x^2 + 41x + 160) - (x^2 - 39x + 112) = 80x + 48$

22. 设 $f(x) = x^2 + 43x + 170$, $g(x) = x^2 - 41x + 120$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 43x + 170) + (x^2 - 41x + 120) = 2x^2 + 2x + 290$
 $f(x) - g(x) = (x^2 + 43x + 170) - (x^2 - 41x + 120) = 84x + 50$

23. 设 $f(x) = x^2 + 45x + 180$, $g(x) = x^2 - 43x + 130$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 45x + 180) + (x^2 - 43x + 130) = 2x^2 + 2x + 310$
 $f(x) - g(x) = (x^2 + 45x + 180) - (x^2 - 43x + 130) = 88x + 52$

24. 设 $f(x) = x^2 + 47x + 190$, $g(x) = x^2 - 45x + 140$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 47x + 190) + (x^2 - 45x + 140) = 2x^2 + 2x + 330$
 $f(x) - g(x) = (x^2 + 47x + 190) - (x^2 - 45x + 140) = 92x + 54$

25. 设 $f(x) = x^2 + 49x + 200$, $g(x) = x^2 - 47x + 150$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 49x + 200) + (x^2 - 47x + 150) = 2x^2 + 2x + 350$
 $f(x) - g(x) = (x^2 + 49x + 200) - (x^2 - 47x + 150) = 96x + 56$

26. 设 $f(x) = x^2 + 51x + 210$, $g(x) = x^2 - 49x + 160$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 51x + 210) + (x^2 - 49x + 160) = 2x^2 + 2x + 370$
 $f(x) - g(x) = (x^2 + 51x + 210) - (x^2 - 49x + 160) = 100x + 58$

27. 设 $f(x) = x^2 + 53x + 220$, $g(x) = x^2 - 51x + 170$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 53x + 220) + (x^2 - 51x + 170) = 2x^2 + 2x + 390$
 $f(x) - g(x) = (x^2 + 53x + 220) - (x^2 - 51x + 170) = 104x + 60$

28. 设 $f(x) = x^2 + 55x + 230$, $g(x) = x^2 - 53x + 180$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 55x + 230) + (x^2 - 53x + 180) = 2x^2 + 2x + 410$
 $f(x) - g(x) = (x^2 + 55x + 230) - (x^2 - 53x + 180) = 108x + 62$

29. 设 $f(x) = x^2 + 57x + 240$, $g(x) = x^2 - 55x + 190$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 57x + 240) + (x^2 - 55x + 190) = 2x^2 + 2x + 430$
 $f(x) - g(x) = (x^2 + 57x + 240) - (x^2 - 55x + 190) = 112x + 64$

30. 设 $f(x) = x^2 + 59x + 250$, $g(x) = x^2 - 57x + 200$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 59x + 250) + (x^2 - 57x + 200) = 2x^2 + 2x + 450$
 $f(x) - g(x) = (x^2 + 59x + 250) - (x^2 - 57x + 200) = 116x + 66$

31. 设 $f(x) = x^2 + 61x + 260$, $g(x) = x^2 - 59x + 210$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 61x + 260) + (x^2 - 59x + 210) = 2x^2 + 2x + 470$
 $f(x) - g(x) = (x^2 + 61x + 260) - (x^2 - 59x + 210) = 120x + 68$

32. 设 $f(x) = x^2 + 63x + 270$, $g(x) = x^2 - 61x + 220$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 63x + 270) + (x^2 - 61x + 220) = 2x^2 + 2x + 490$
 $f(x) - g(x) = (x^2 + 63x + 270) - (x^2 - 61x + 220) = 124x + 70$

33. 设 $f(x) = x^2 + 65x + 280$, $g(x) = x^2 - 63x + 230$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 65x + 280) + (x^2 - 63x + 230) = 2x^2 + 2x + 510$
 $f(x) - g(x) = (x^2 + 65x + 280) - (x^2 - 63x + 230) = 128x + 72$

34. 设 $f(x) = x^2 + 67x + 290$, $g(x) = x^2 - 65x + 240$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 67x + 290) + (x^2 - 65x + 240) = 2x^2 + 2x + 530$
 $f(x) - g(x) = (x^2 + 67x + 290) - (x^2 - 65x + 240) = 132x + 74$

35. 设 $f(x) = x^2 + 69x + 300$, $g(x) = x^2 - 67x + 250$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 69x + 300) + (x^2 - 67x + 250) = 2x^2 + 2x + 550$
 $f(x) - g(x) = (x^2 + 69x + 300) - (x^2 - 67x + 250) = 136x + 76$

36. 设 $f(x) = x^2 + 71x + 310$, $g(x) = x^2 - 69x + 260$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 71x + 310) + (x^2 - 69x + 260) = 2x^2 + 2x + 570$
 $f(x) - g(x) = (x^2 + 71x + 310) - (x^2 - 69x + 260) = 140x + 78$

37. 设 $f(x) = x^2 + 73x + 320$, $g(x) = x^2 - 71x + 270$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 73x + 320) + (x^2 - 71x + 270) = 2x^2 + 2x + 590$
 $f(x) - g(x) = (x^2 + 73x + 320) - (x^2 - 71x + 270) = 144x + 80$

38. 设 $f(x) = x^2 + 75x + 330$, $g(x) = x^2 - 73x + 280$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 75x + 330) + (x^2 - 73x + 280) = 2x^2 + 2x + 610$
 $f(x) - g(x) = (x^2 + 75x + 330) - (x^2 - 73x + 280) = 148x + 82$

39. 设 $f(x) = x^2 + 77x + 340$, $g(x) = x^2 - 75x + 290$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 77x + 340) + (x^2 - 75x + 290) = 2x^2 + 2x + 630$
 $f(x) - g(x) = (x^2 + 77x + 340) - (x^2 - 75x + 290) = 152x + 84$

40. 设 $f(x) = x^2 + 79x + 350$, $g(x) = x^2 - 77x + 300$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 79x + 350) + (x^2 - 77x + 300) = 2x^2 + 2x + 650$
 $f(x) - g(x) = (x^2 + 79x + 350) - (x^2 - 77x + 300) = 156x + 86$

41. 设 $f(x) = x^2 + 81x + 360$, $g(x) = x^2 - 79x + 310$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 81x + 360) + (x^2 - 79x + 310) = 2x^2 + 2x + 670$
 $f(x) - g(x) = (x^2 + 81x + 360) - (x^2 - 79x + 310) = 160x + 88$

42. 设 $f(x) = x^2 + 83x + 370$, $g(x) = x^2 - 81x + 320$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 83x + 370) + (x^2 - 81x + 320) = 2x^2 + 2x + 690$
 $f(x) - g(x) = (x^2 + 83x + 370) - (x^2 - 81x + 320) = 164x + 90$

43. 设 $f(x) = x^2 + 85x + 380$, $g(x) = x^2 - 83x + 330$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 85x + 380) + (x^2 - 83x + 330) = 2x^2 + 2x + 710$
 $f(x) - g(x) = (x^2 + 85x + 380) - (x^2 - 83x + 330) = 168x + 92$

44. 设 $f(x) = x^2 + 87x + 390$, $g(x) = x^2 - 85x + 340$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 87x + 390) + (x^2 - 85x + 340) = 2x^2 + 2x + 730$
 $f(x) - g(x) = (x^2 + 87x + 390) - (x^2 - 85x + 340) = 172x + 94$

45. 设 $f(x) = x^2 + 89x + 400$, $g(x) = x^2 - 87x + 350$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 89x + 400) + (x^2 - 87x + 350) = 2x^2 + 2x + 750$
 $f(x) - g(x) = (x^2 + 89x + 400) - (x^2 - 87x + 350) = 176x + 96$

46. 设 $f(x) = x^2 + 91x + 410$, $g(x) = x^2 - 89x + 360$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 91x + 410) + (x^2 - 89x + 360) = 2x^2 + 2x + 770$
 $f(x) - g(x) = (x^2 + 91x + 410) - (x^2 - 89x + 360) = 180x + 98$

47. 设 $f(x) = x^2 + 93x + 420$, $g(x) = x^2 - 91x + 370$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 93x + 420) + (x^2 - 91x + 370) = 2x^2 + 2x + 790$
 $f(x) - g(x) = (x^2 + 93x + 420) - (x^2 - 91x + 370) = 184x + 100$

48. 设 $f(x) = x^2 + 95x + 430$, $g(x) = x^2 - 93x + 380$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 95x + 430) + (x^2 - 93x + 380) = 2x^2 + 2x + 810$
 $f(x) - g(x) = (x^2 + 95x + 430) - (x^2 - 93x + 380) = 188x + 102$

49. 设 $f(x) = x^2 + 97x + 440$, $g(x) = x^2 - 95x + 390$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 97x + 440) + (x^2 - 95x + 390) = 2x^2 + 2x + 830$
 $f(x) - g(x) = (x^2 + 97x + 440) - (x^2 - 95x + 390) = 192x + 104$

50. 设 $f(x) = x^2 + 99x + 450$, $g(x) = x^2 - 97x + 400$, 求 $f(x) + g(x)$ 和 $f(x) - g(x)$.
 解: $f(x) + g(x) = (x^2 + 99x + 450) + (x^2 - 97x + 400) = 2x^2 + 2x + 850$
 $f(x) - g(x) = (x^2 + 99x + 450) - (x^2 - 97x + 400) = 196x + 106$

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LETTER OF TRANSMITTAL.

STATE GEOLOGICAL SURVEY,

UNIVERSITY OF ILLINOIS, Feb. 7, 1912.

Governor C. S. Deneen, Chairman, and Members of the Geological Commission:

GENTLEMEN—I submit herewith manuscript for a report entitled, A study of sand-lime brick, and recommend that it be published as Bulletin No. 18. The report was prepared by Prof. S. W. Parr, consulting chemist of the Survey, in collaboration with Dr. T. R. Ernest.

No sand-lime bricks are now produced in Illinois, though the industry has a footing in neighboring states, and, if we may judge from foreign experience, will become prominent here in the future.

Very respectfully,

FRANK W. DEWOLF,

Director.