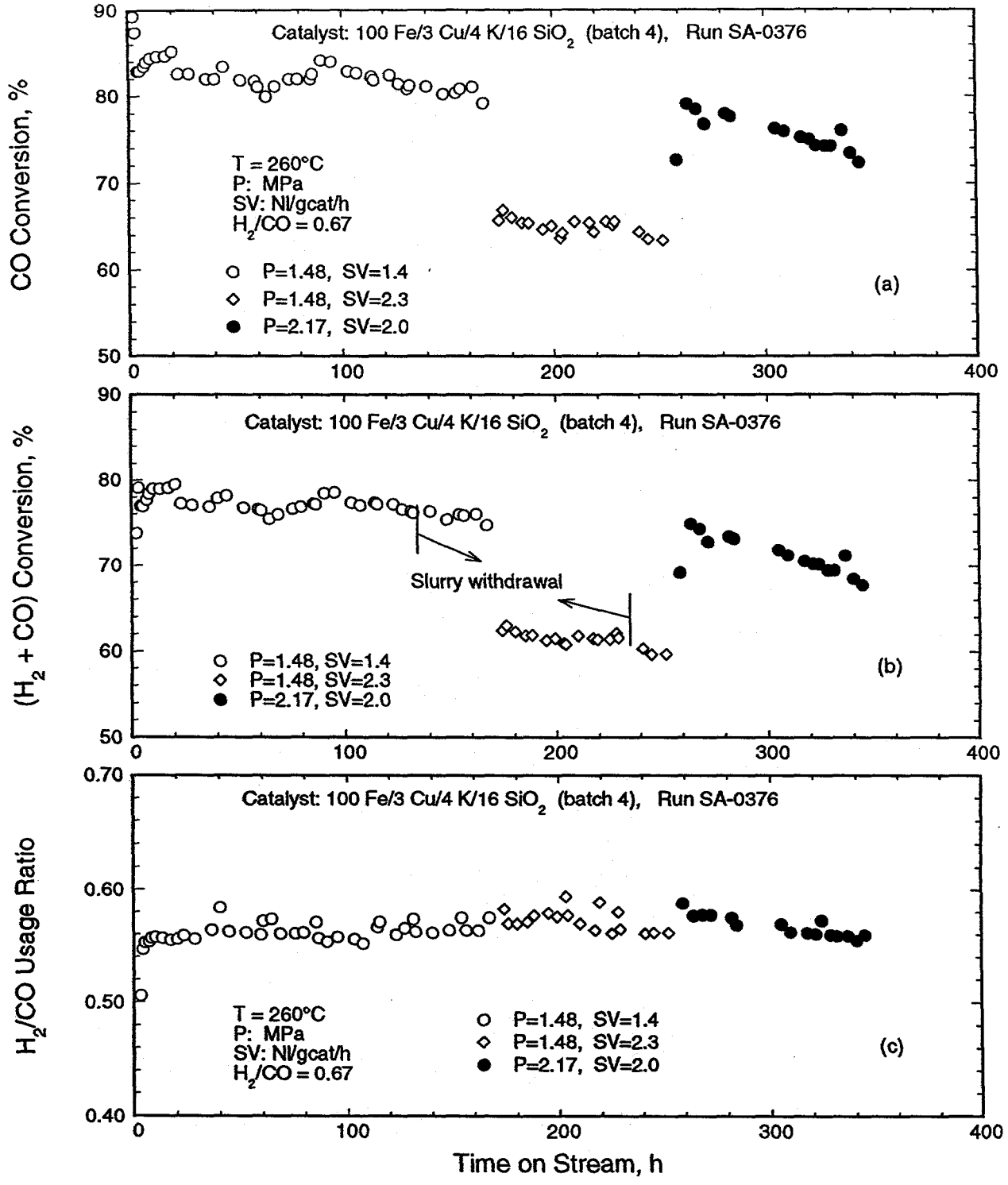

Figure 1. Variation in (a) CO conversion, (b) (H_2+CO) conversion, and (c) H_2/CO usage ratio with time on stream in run SA-0376 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

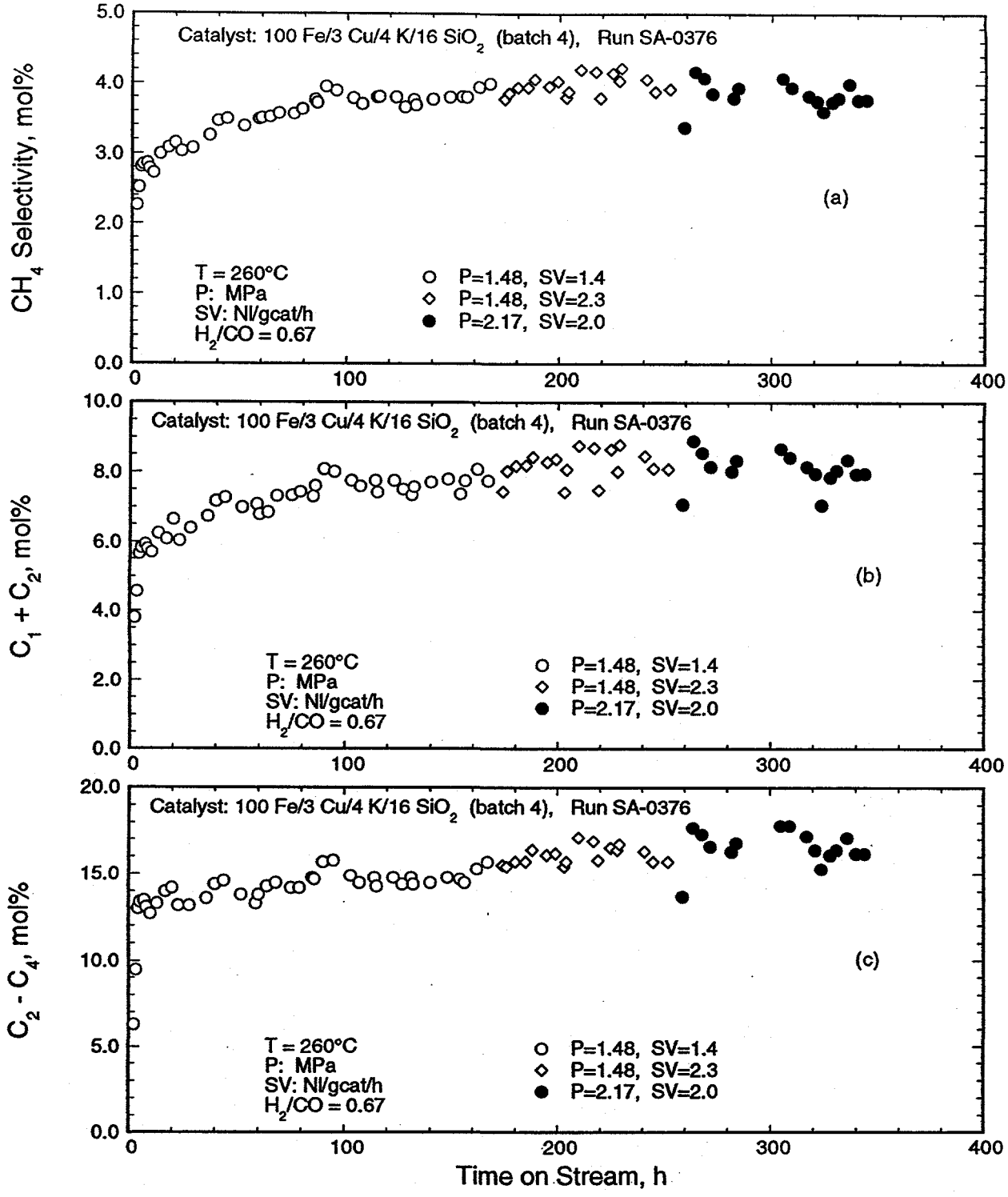

Figure 2. Variation in (a) methane selectivity, (b) C_1+C_2 selectivity and (c) C_2-C_4 selectivity with time on stream in run SA-0376 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

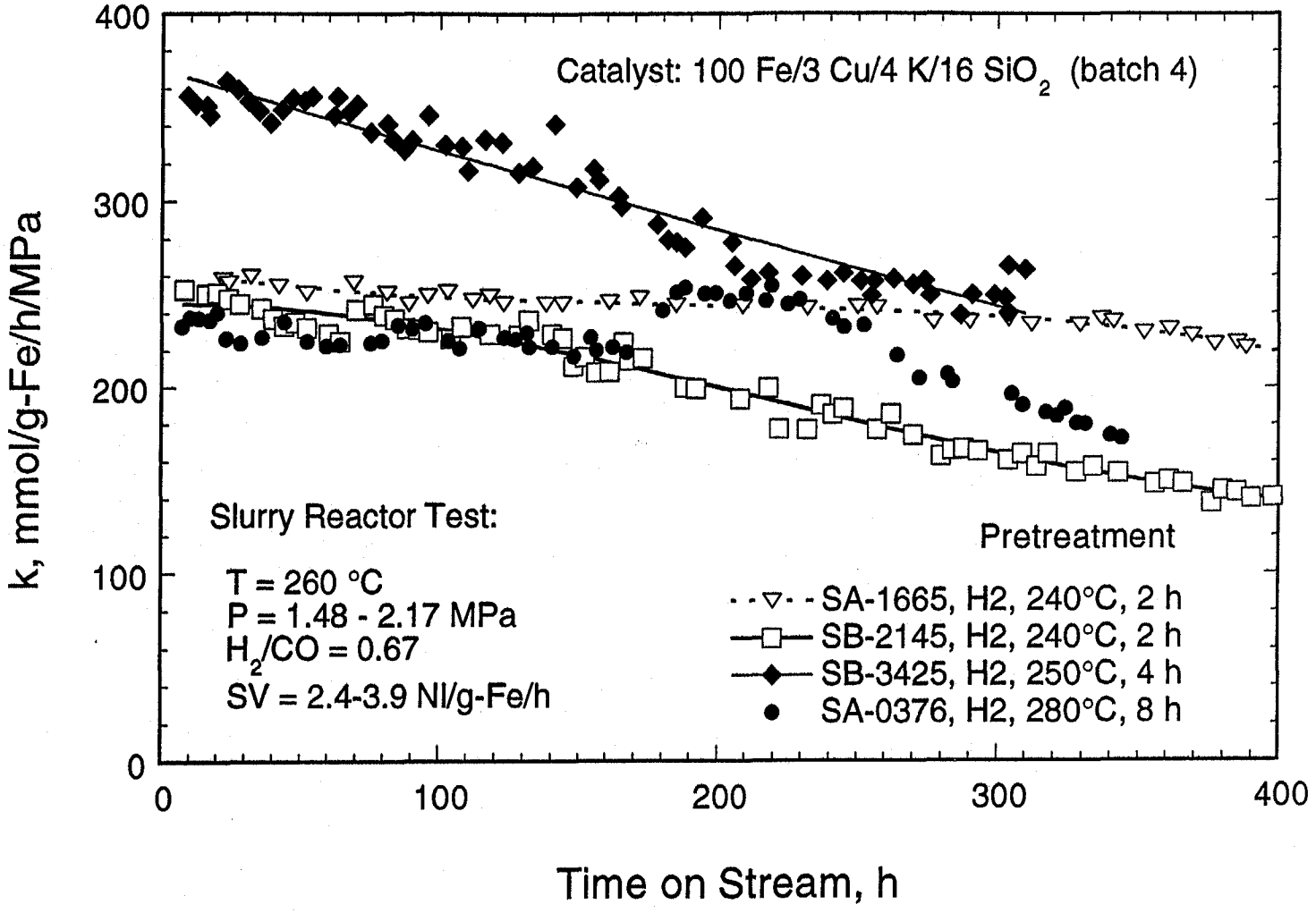

Figure 3. Comparison of an apparent first order reaction rate constant among runs SA-1665, SB-2145, SB-3425 and SA-0376 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst using different pretreatment procedures.

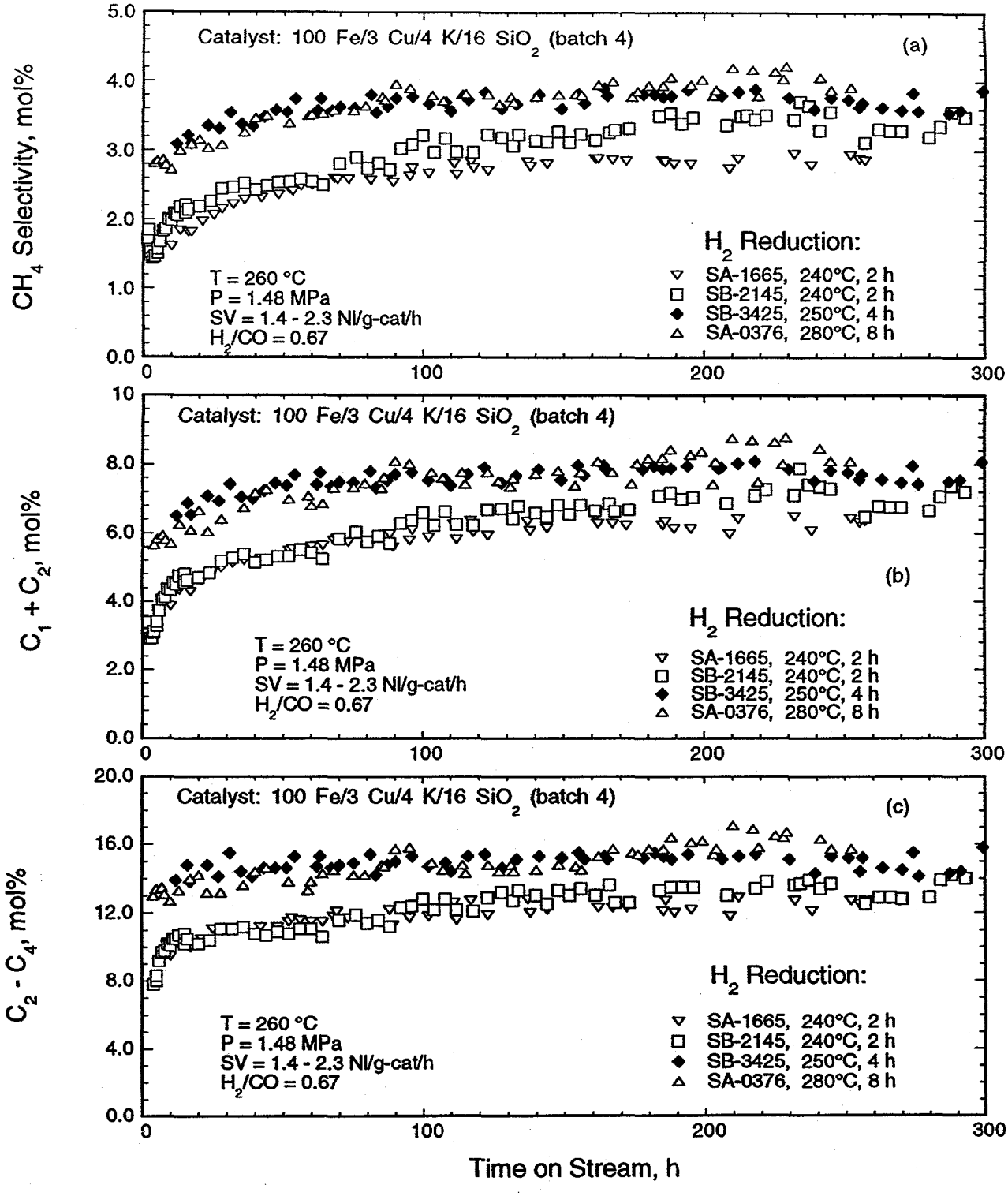

Figure 4. Comparison of (a) methane selectivity, (b) C_1+C_2 selectivity and (c) C_2-C_4 selectivity among runs SA-1665, SB-2145, SB-3425 and SA-0376 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

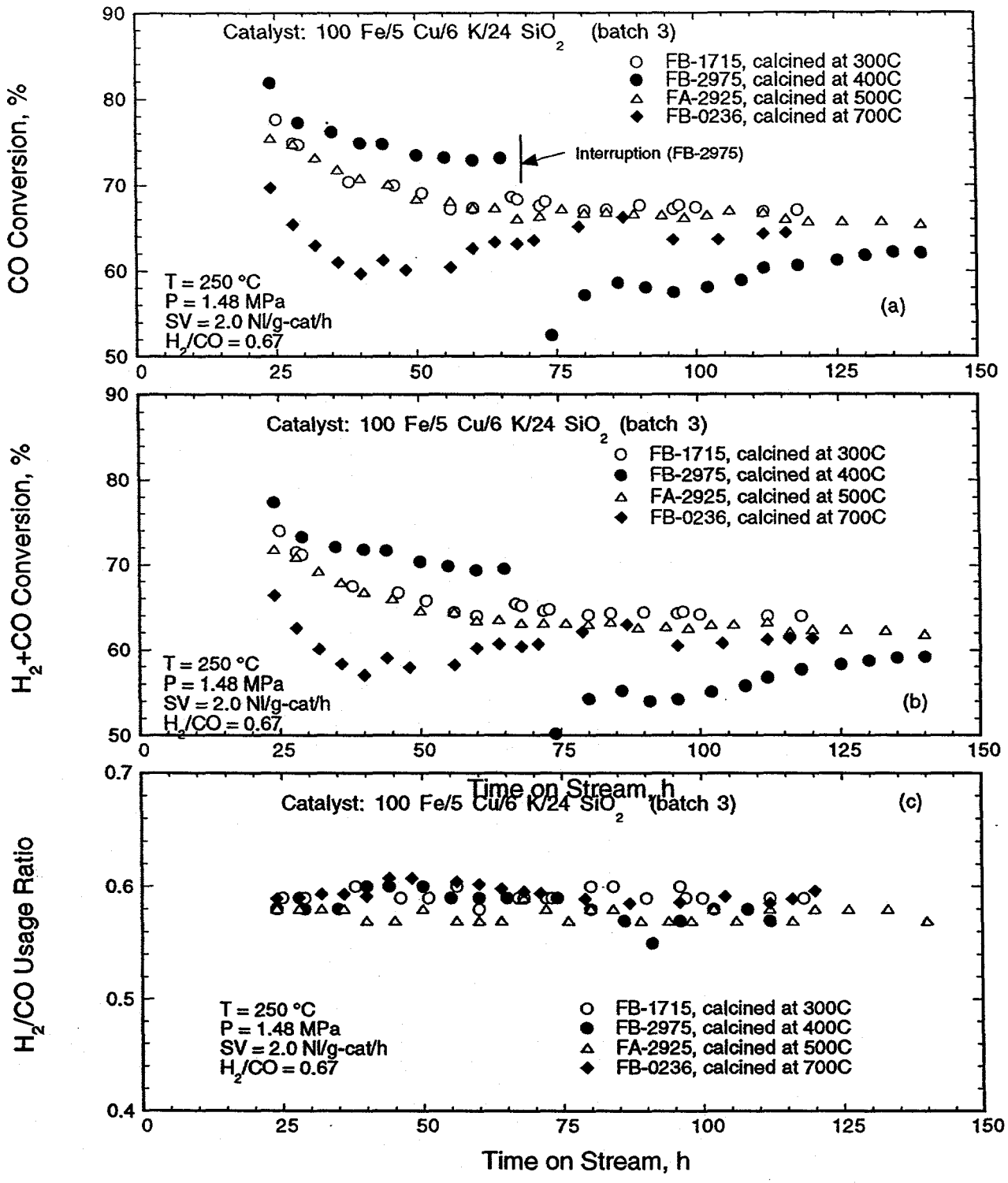

Figure 5. Effect of calcination temperature on (a) CO conversion, (b) (H_2+CO) syngas conversion, and (c) H_2/CO usage ratio in FBR tests with the 100 Fe/5 Cu/6 K/24 SiO_2 catalyst.

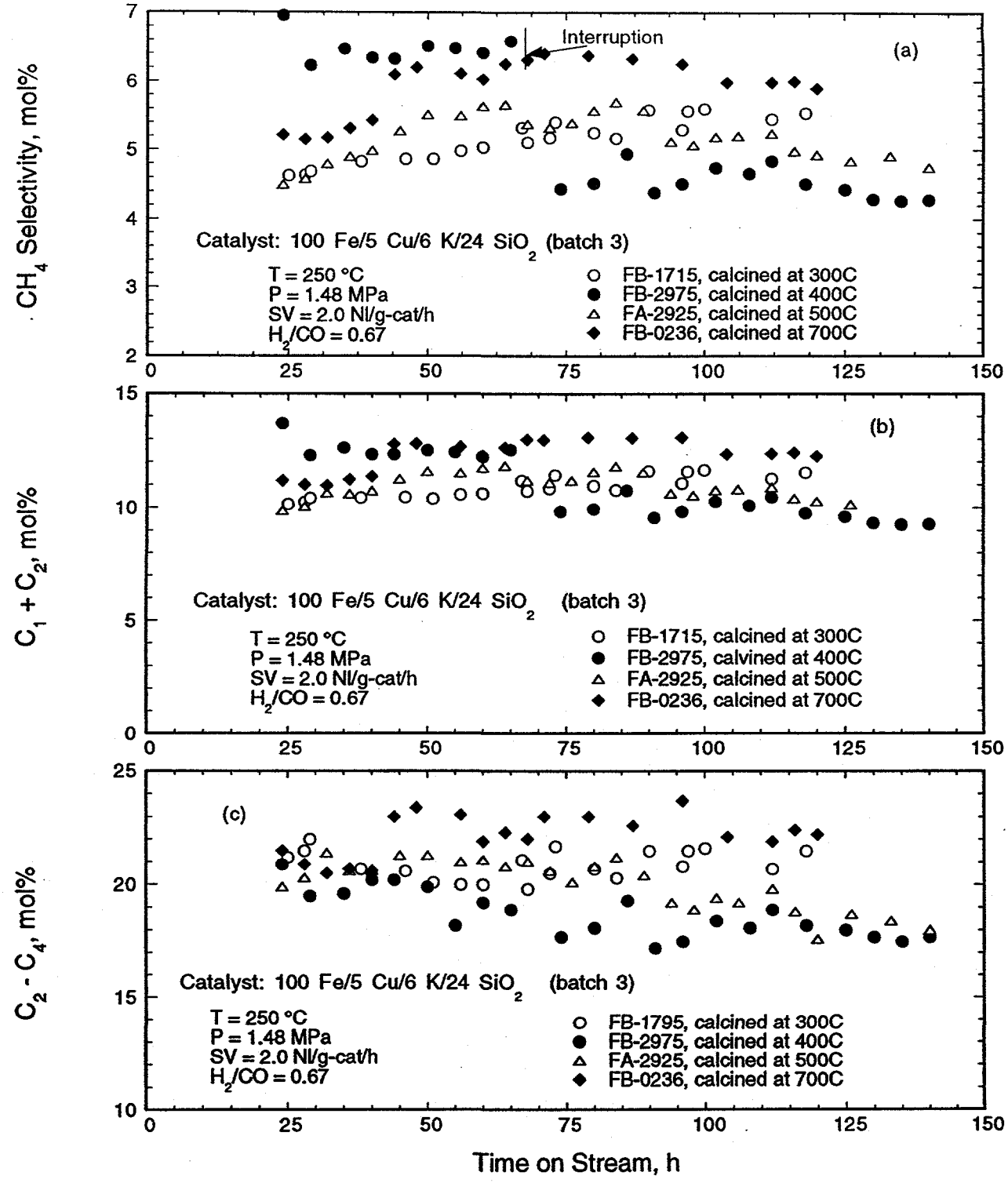

Figure 6. Effect of calcination conditions on (a) methane selectivity, (b) C_1+C_2 selectivity and (c) C_2-C_4 selectivity in FBR tests with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

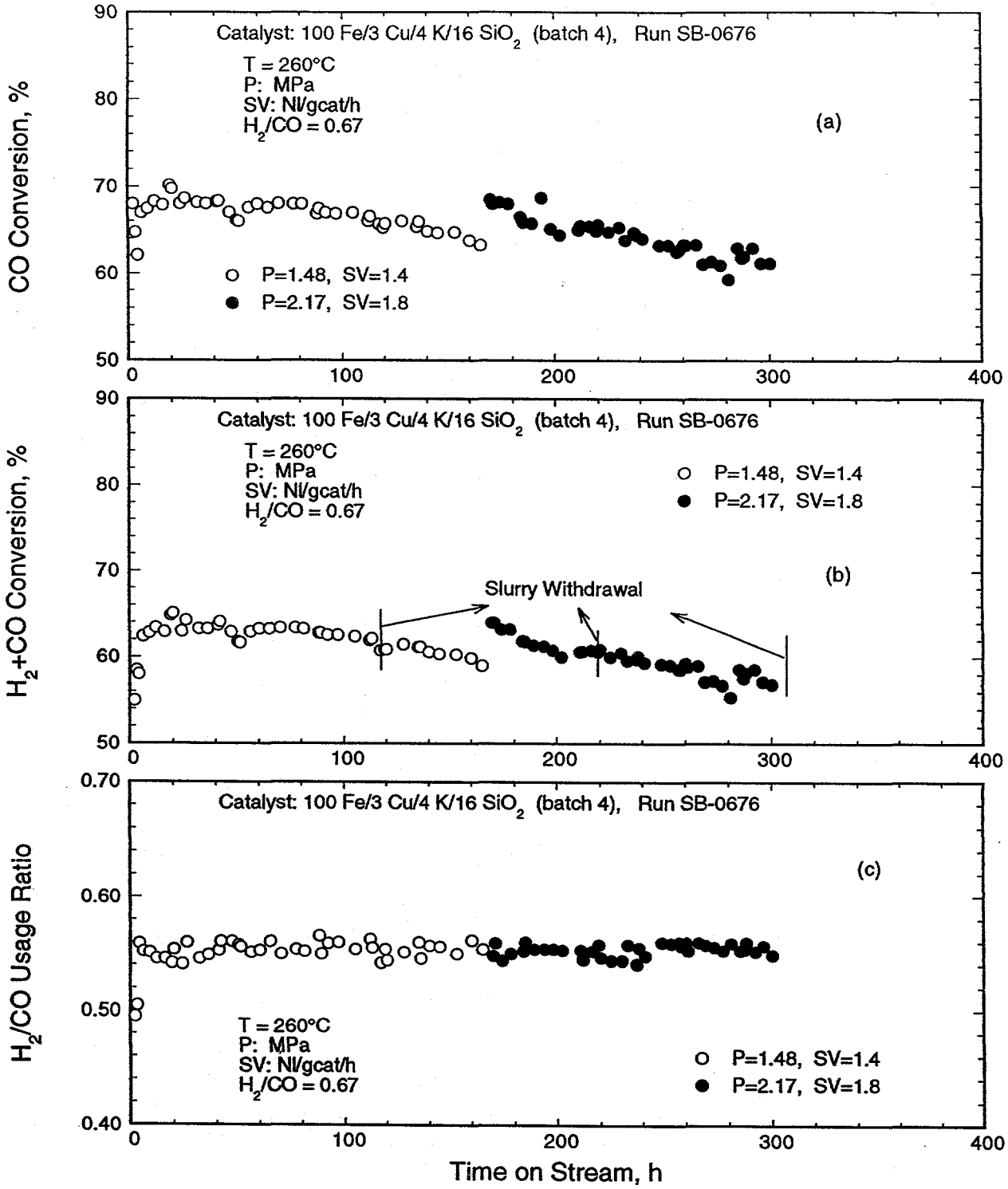

Figure 7. Change in (a) CO conversion, (b) (H_2+CO) conversion, and (c) H_2/CO usage ratio with time on stream in run SB-0676 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

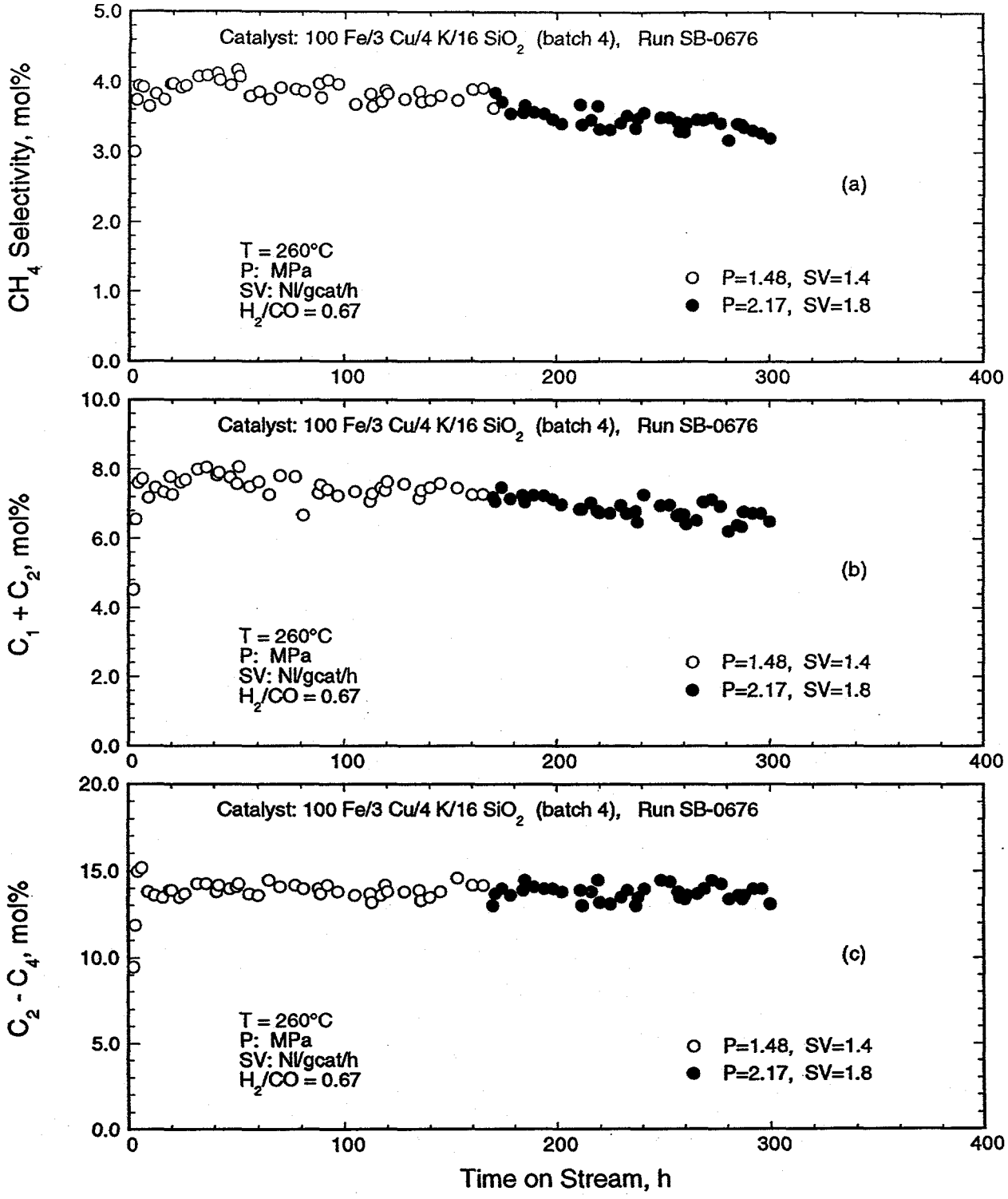

Figure 8. Change in (a) methane selectivity, (b) C_1+C_2 selectivity and (c) C_2-C_4 selectivity with time on stream in run SB-0676 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

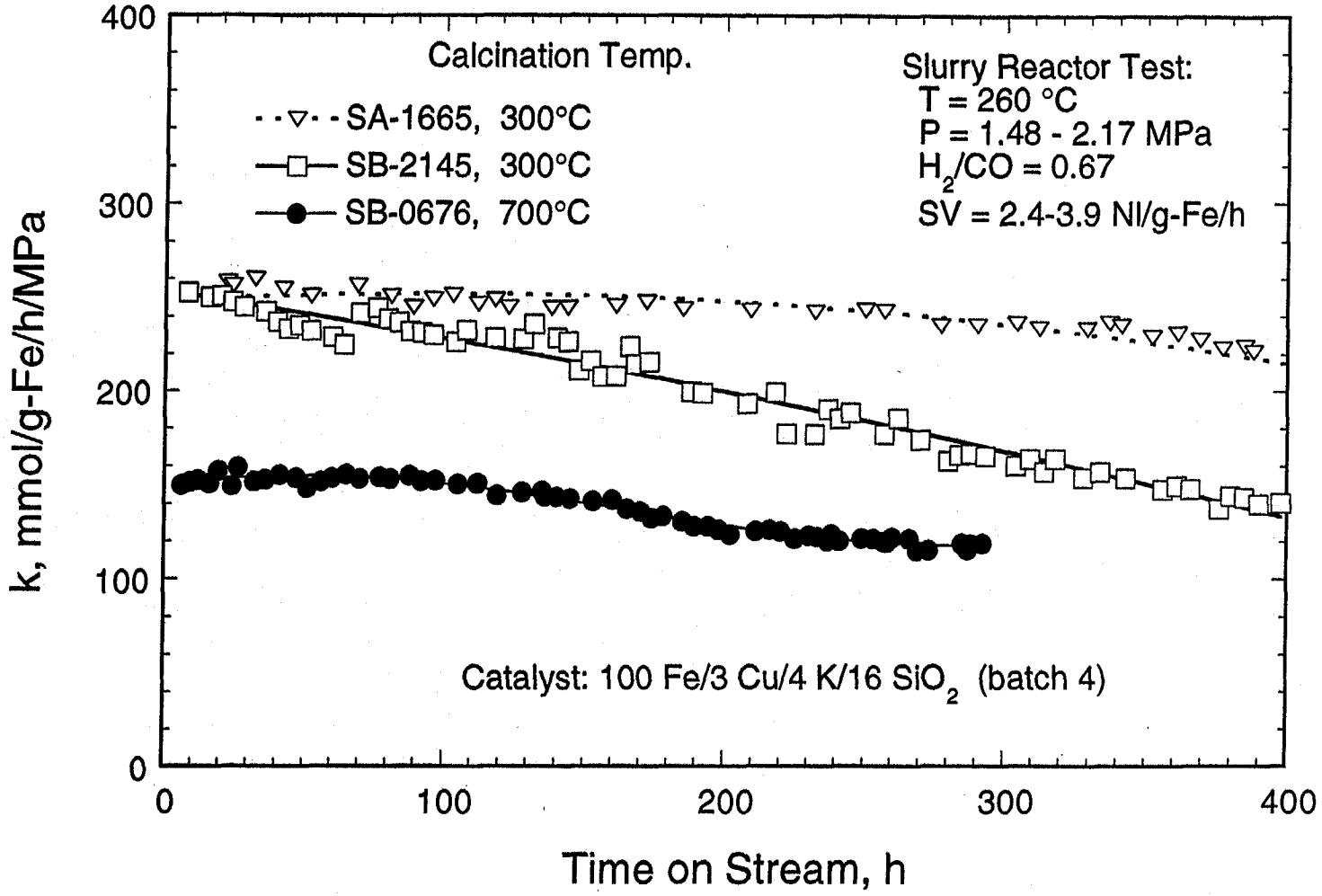

Figure 9. Comparison of an apparent first order reaction rate constant among runs SA-1665, SB-2145 and SB-0676 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst using different calcination procedures.

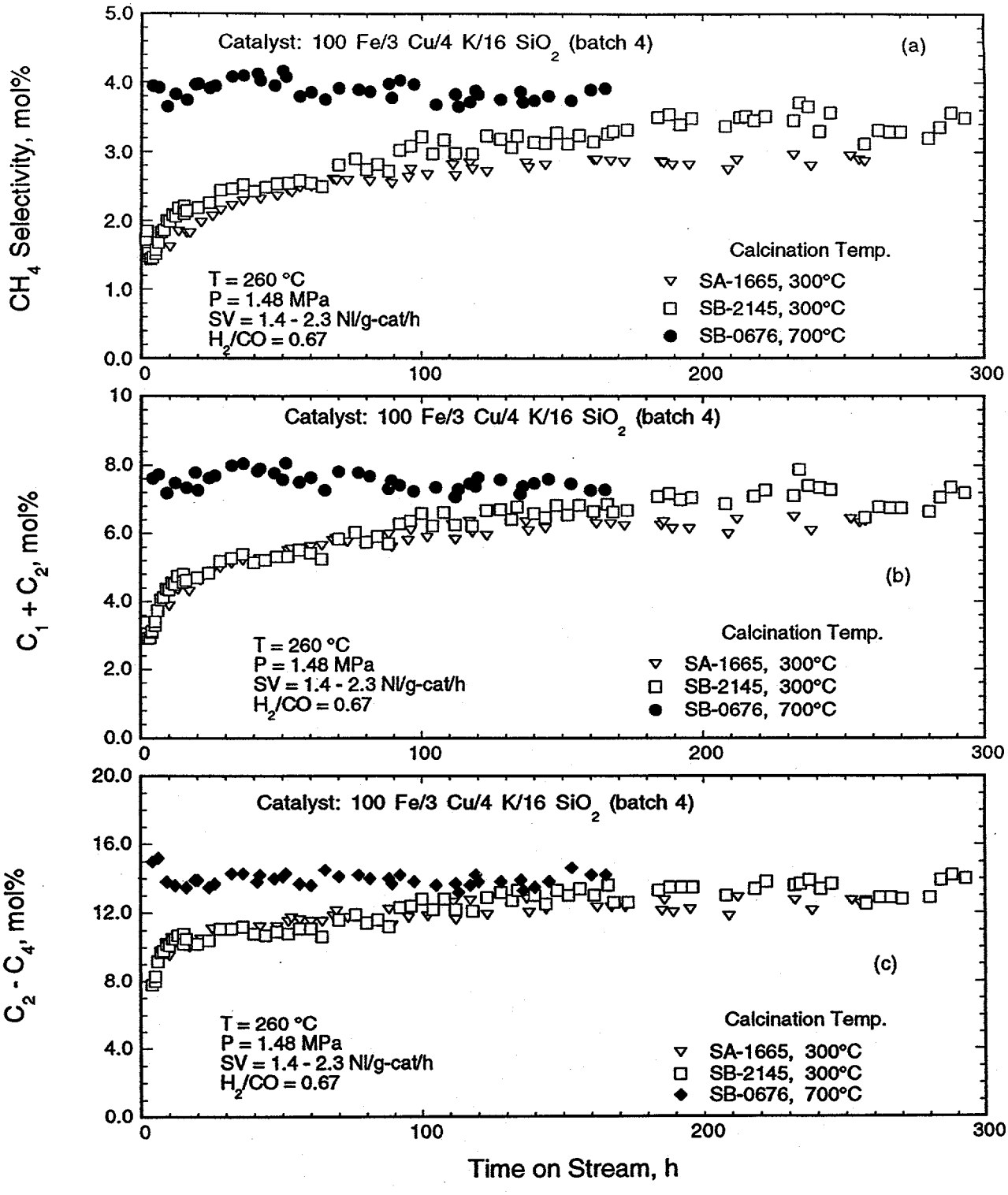

Figure 10. Comparison of (a) methane selectivity, (b) C_1+C_2 selectivity and (c) C_2-C_4 selectivity among runs SA-1665, SB-2145 and SB-0676 with the 100 Fe/3 Cu/4 K/16 SiO_2 catalyst.

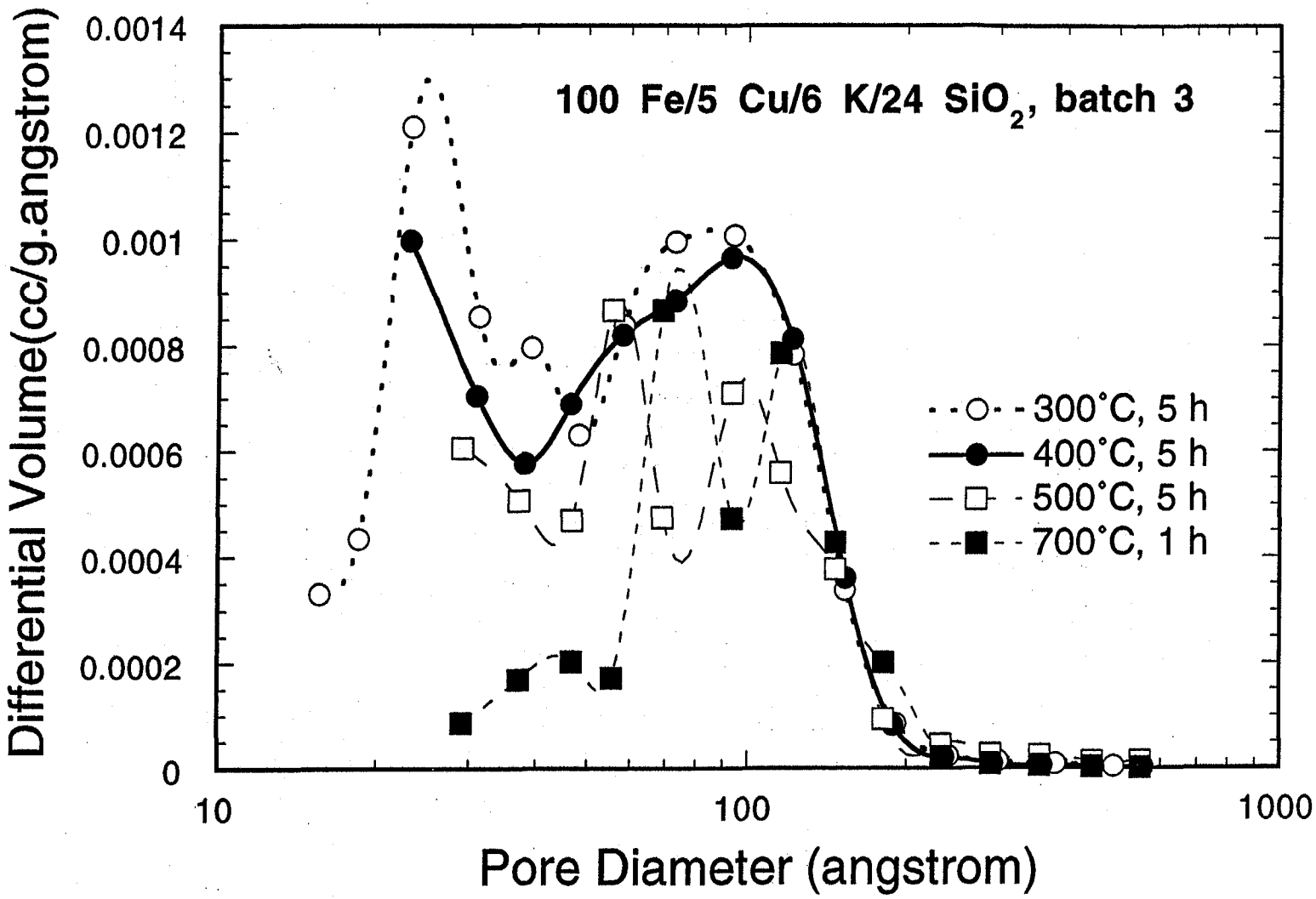

Figure 11. Pore size distribution of catalyst B (100 Fe/5 Cu/6 K/24 SiO_2, batch 3), calcined under different conditions.

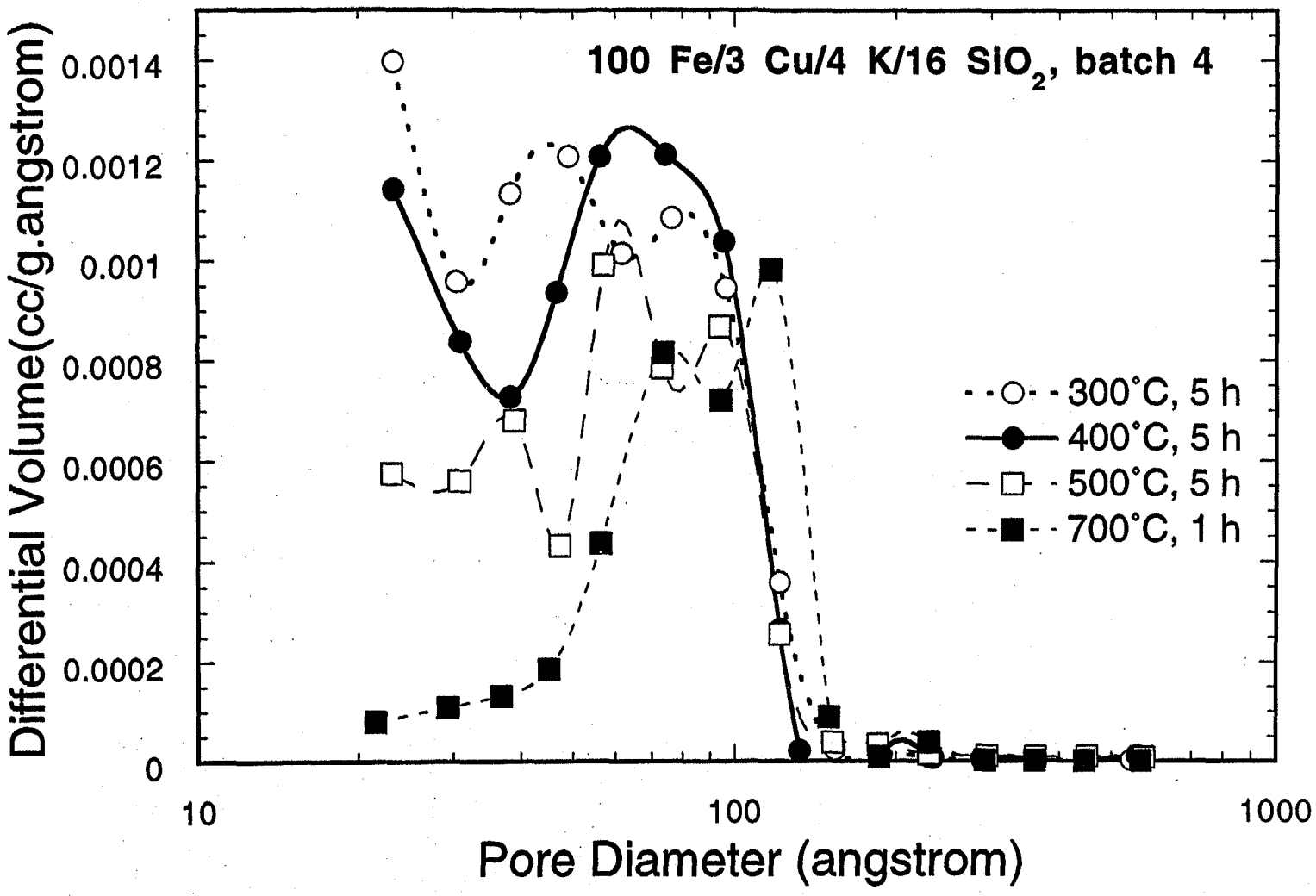

Figure 12. Pore size distribution of catalyst C (100 Fe/3 Cu/4 K/16 SiO_2, batch 4), calcined under different conditions.

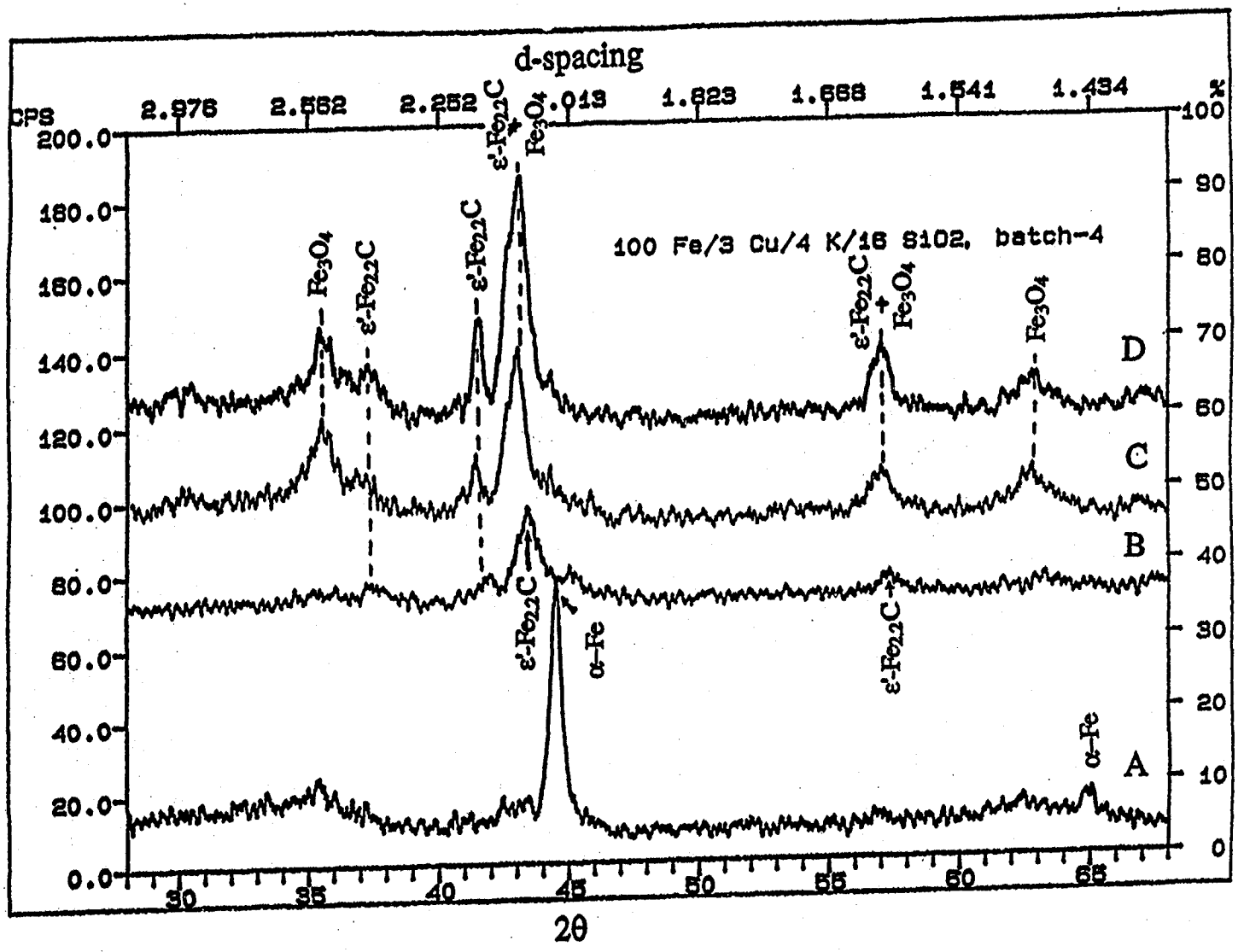

Figure 13. Change in bulk iron phases with time on stream during run SA-0376 with catalyst C (100 Fe/3 Cu/4 K/16 SiO_2, batch 4): (A) TOS=0 h; (B) TOS=134 h; (C) TOS=230 h; and (D) TOS=350 h.

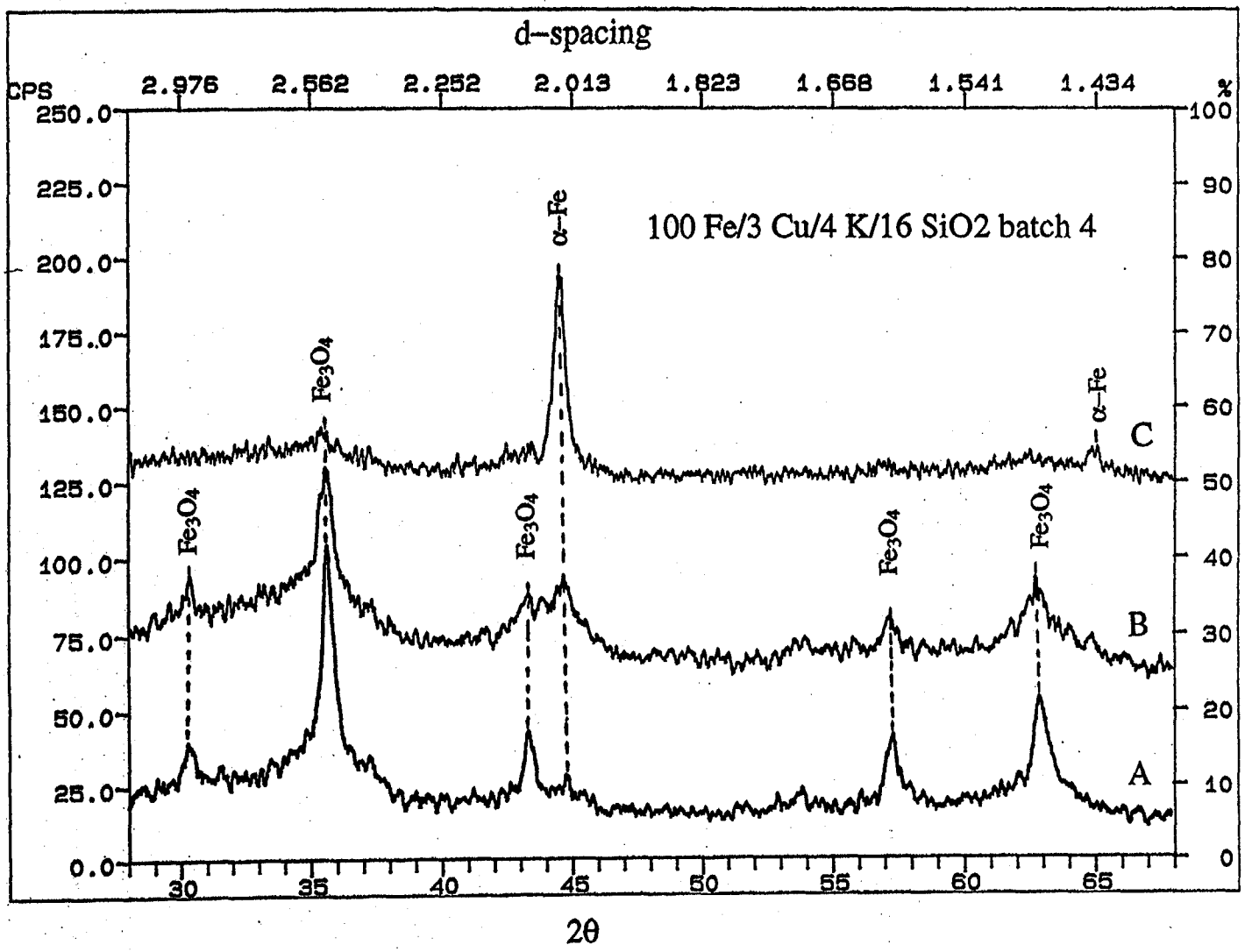

Figure 14. Effect of hydrogen reduction temperature and duration on the changes of bulk iron phases of the catalyst C (100Fe/ 3 Cu/4 K/16 SiO_2, batch 4): (A) SB-2145, H_2, 240°C, 2 h; (B) SB-3425, H_2, 250°C, 5h; (C) SA-0376, H_2, 280°C, 8 h.

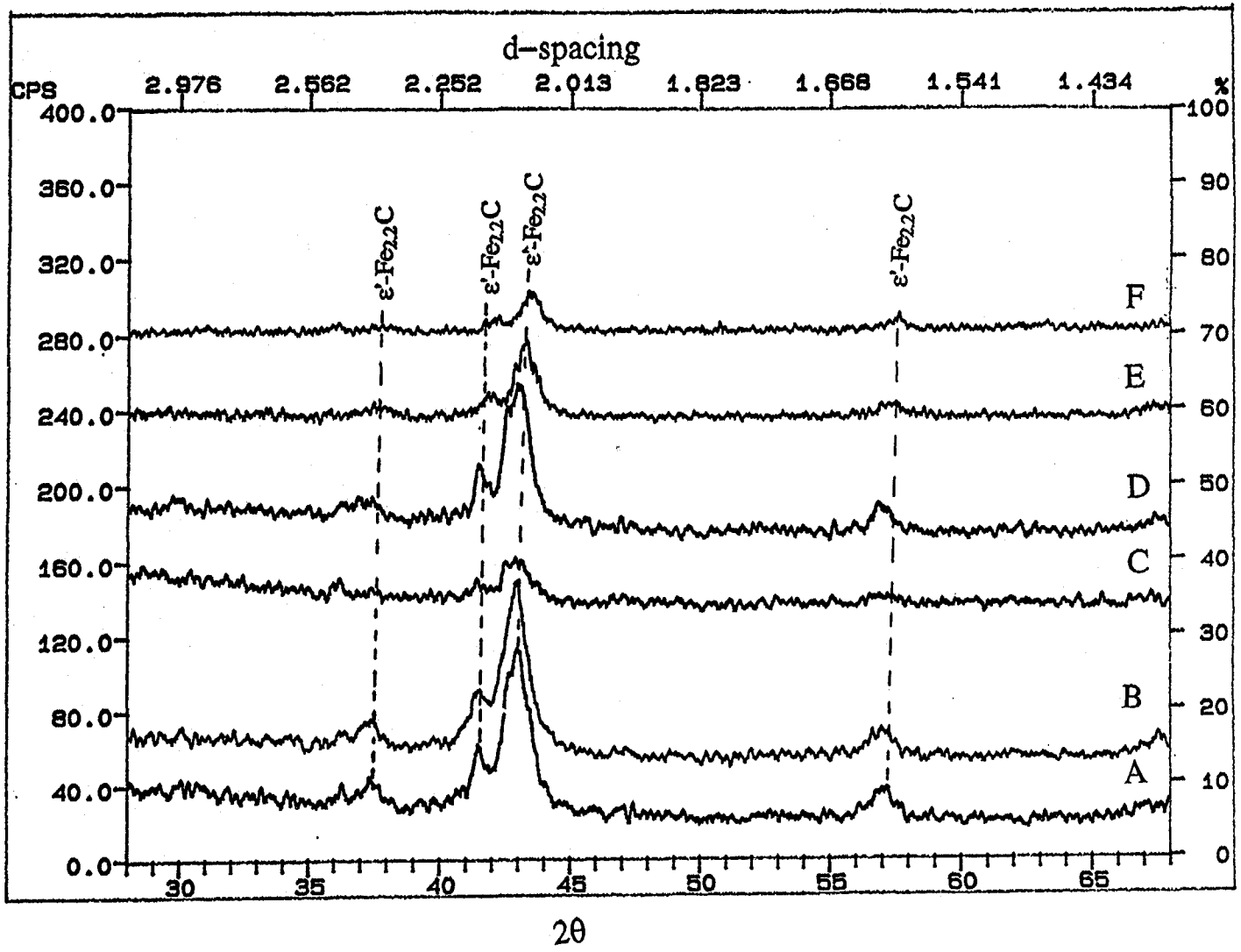

Figure 15. XRD patterns of the used catalysts from fixed bed reactor tests for calcination research: (A) FB-2975 (calcined at 400°C for 5 h), top, TOS=142 h; (B) FB-2975, bottom; (C) FA-2925 (calcined at 500°C for 5 h), top, TOS=140 h; (D) FA-2925, bottom; (E) FB-0236 (calcined at 700°C for 1 h), top, TOS=120 h; (F) FB-0236, bottom.

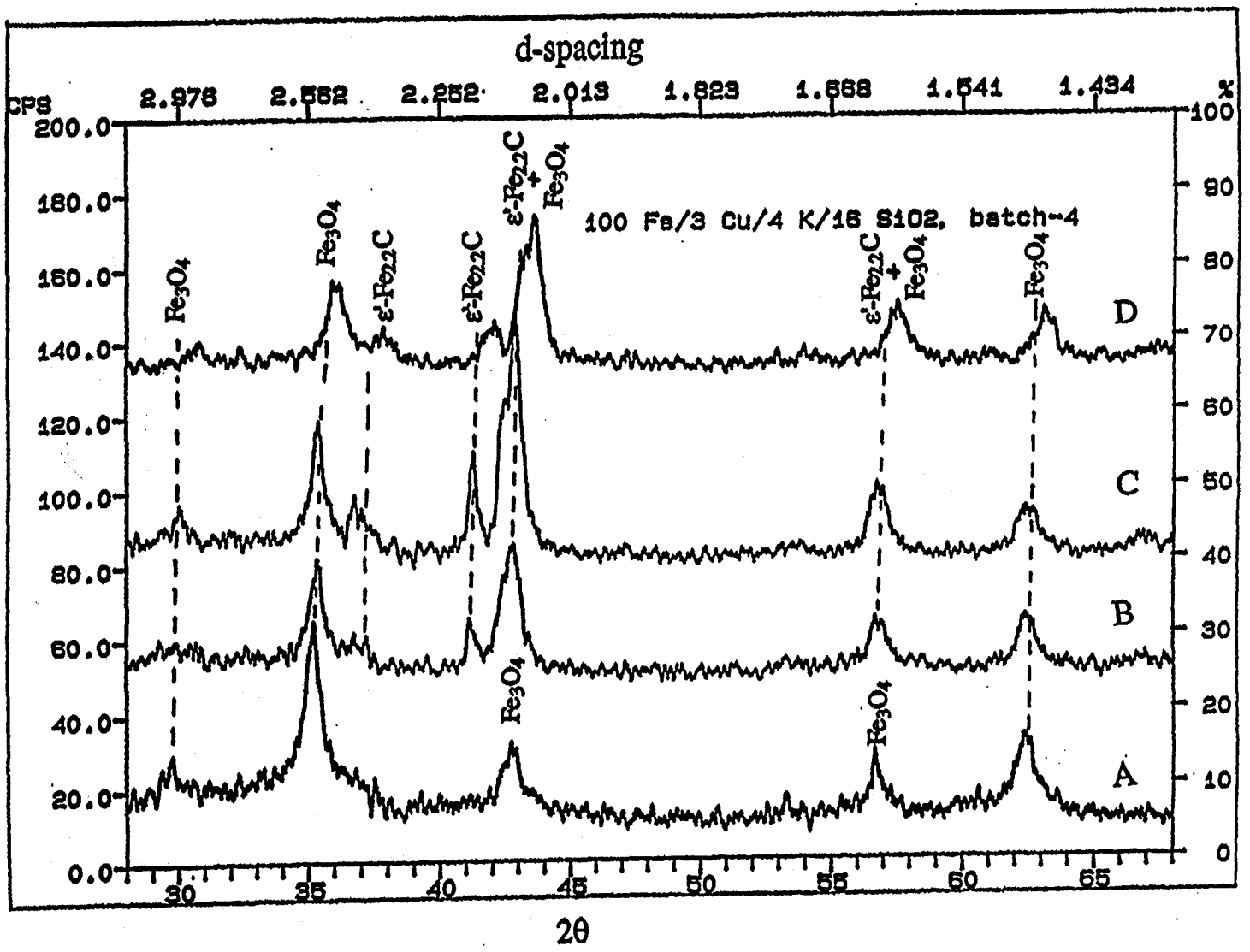

Figure 16. Change in bulk iron phases with time on stream during run SB-0676 with catalyst C (100 Fe/3 Cu/4 K/16 SiO_2, batch 4): (A) TOS=0 h; (B) TOS=120 h; (C) TOS=221 h; and (D) TOS=305 h.

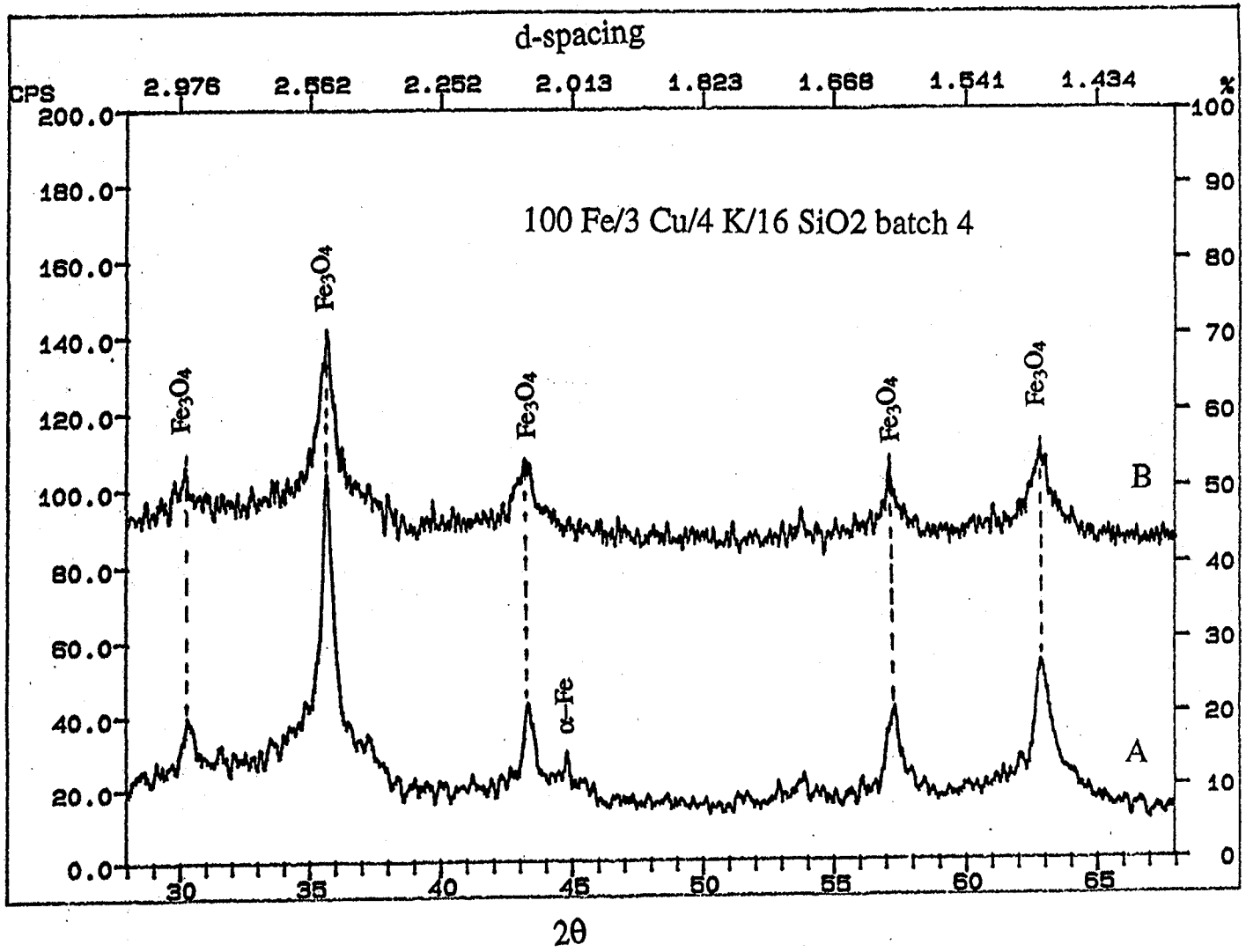

Figure 17. XRD patterns of catalyst samples withdrawn from slurry reactor tests for calcination research: (A) SB-2145 (calcined at 300°C for 5 h), H_2, 240°C, 0.78 MPa, 2 h, TOS=0 h; (B) SB-0676 (calcined at 700C for 1 h), H_2, 240°C, 0.78 MPa, 2 h, TOS=0 h.

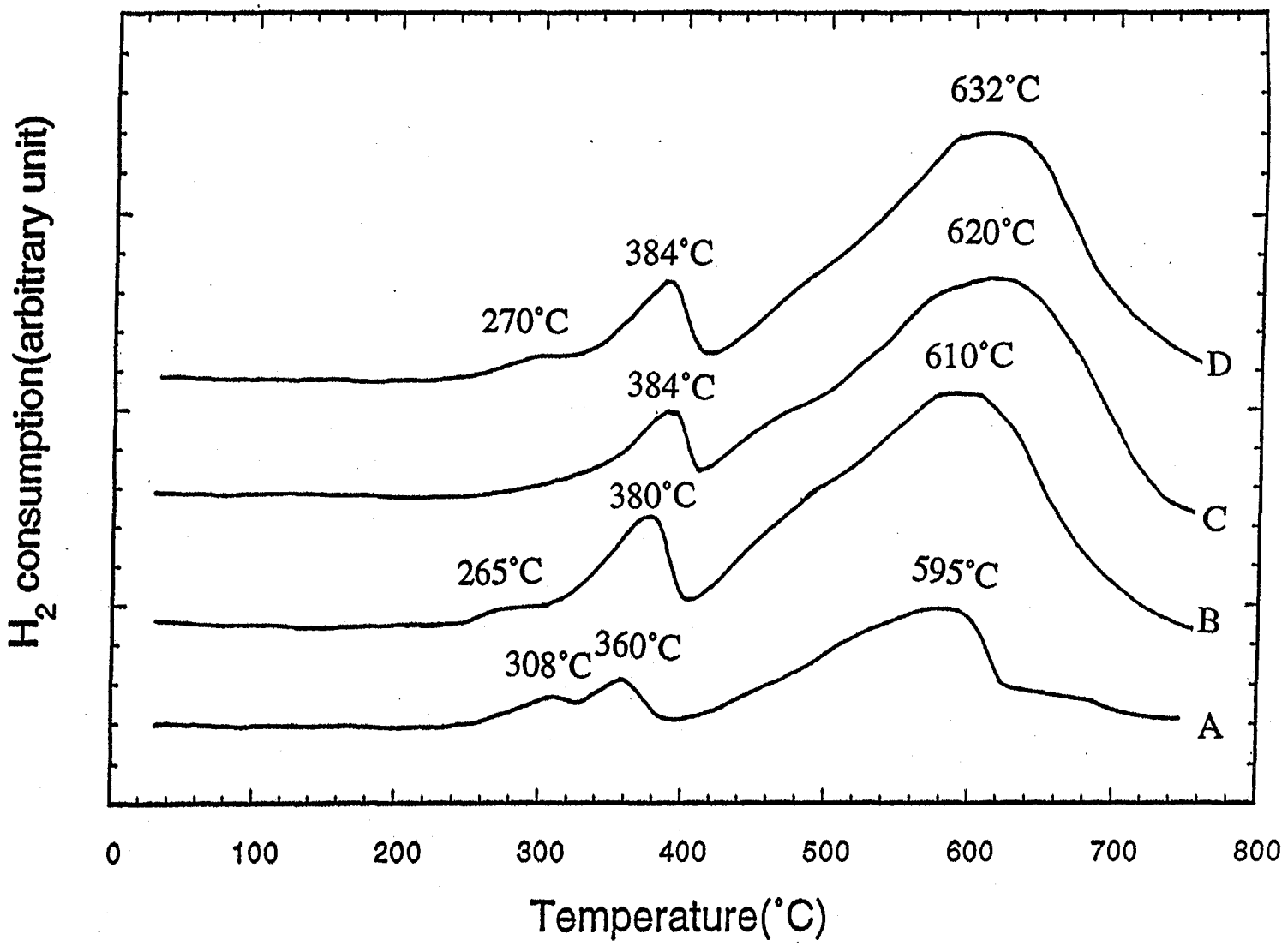

Figure 18. Effect of potassium addition on the TPR profiles of iron catalysts precalcined at 300°C, 5 h: (A) 100 Fe/0 K; (B) 100 Fe/0.2 K; (C) 100 Fe/0.5 K and (D) 100 Fe/1 K.

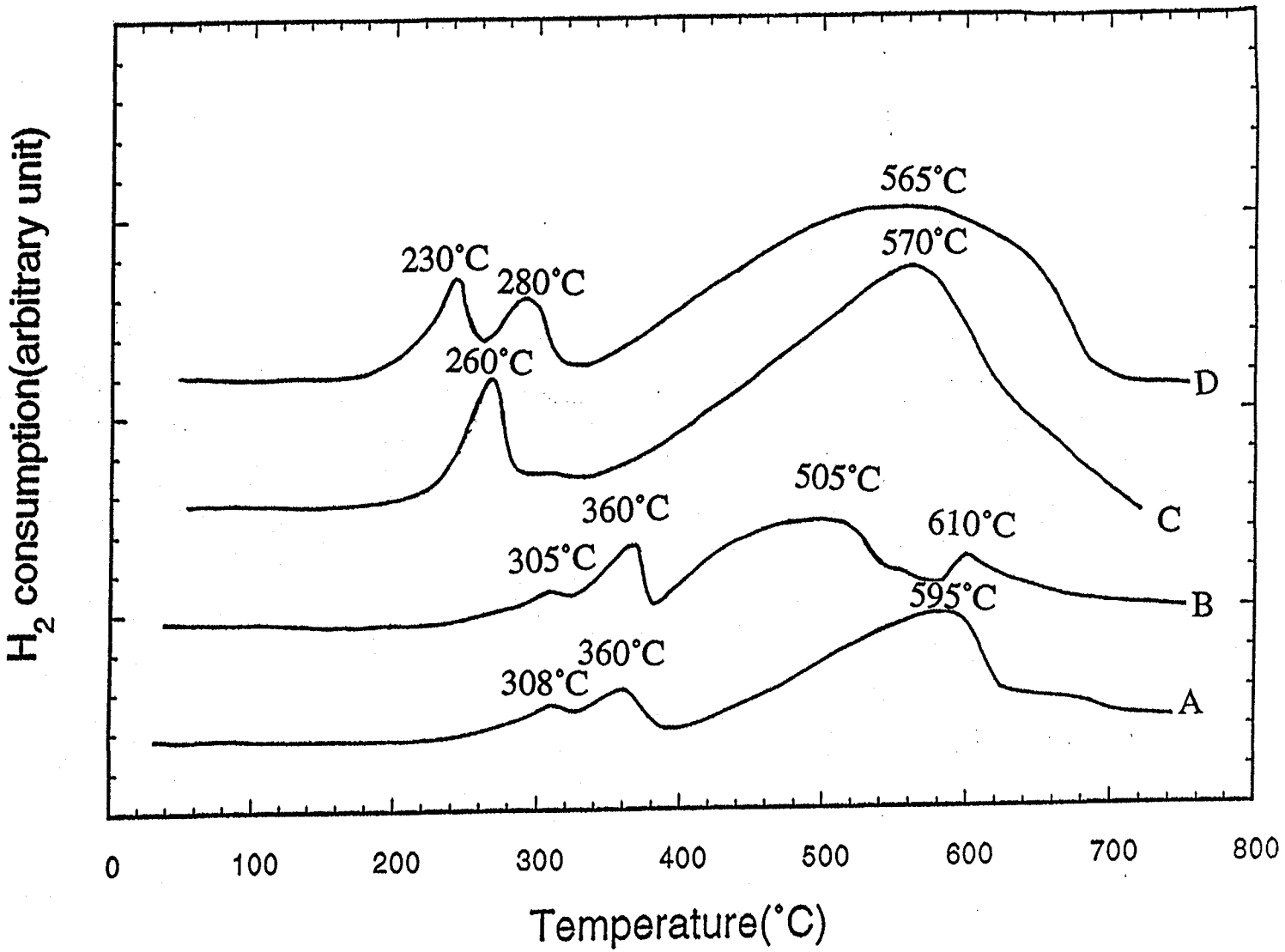

Figure 19. Effect of copper addition on the TPR profiles of iron catalysts precalcined at 300°C, 5 h: (A) 100 Fe/0 Cu (B) 100 Fe/0.3 Cu; (C) 100 Fe/3 Cu and (D) 100 Fe/5 Cu.

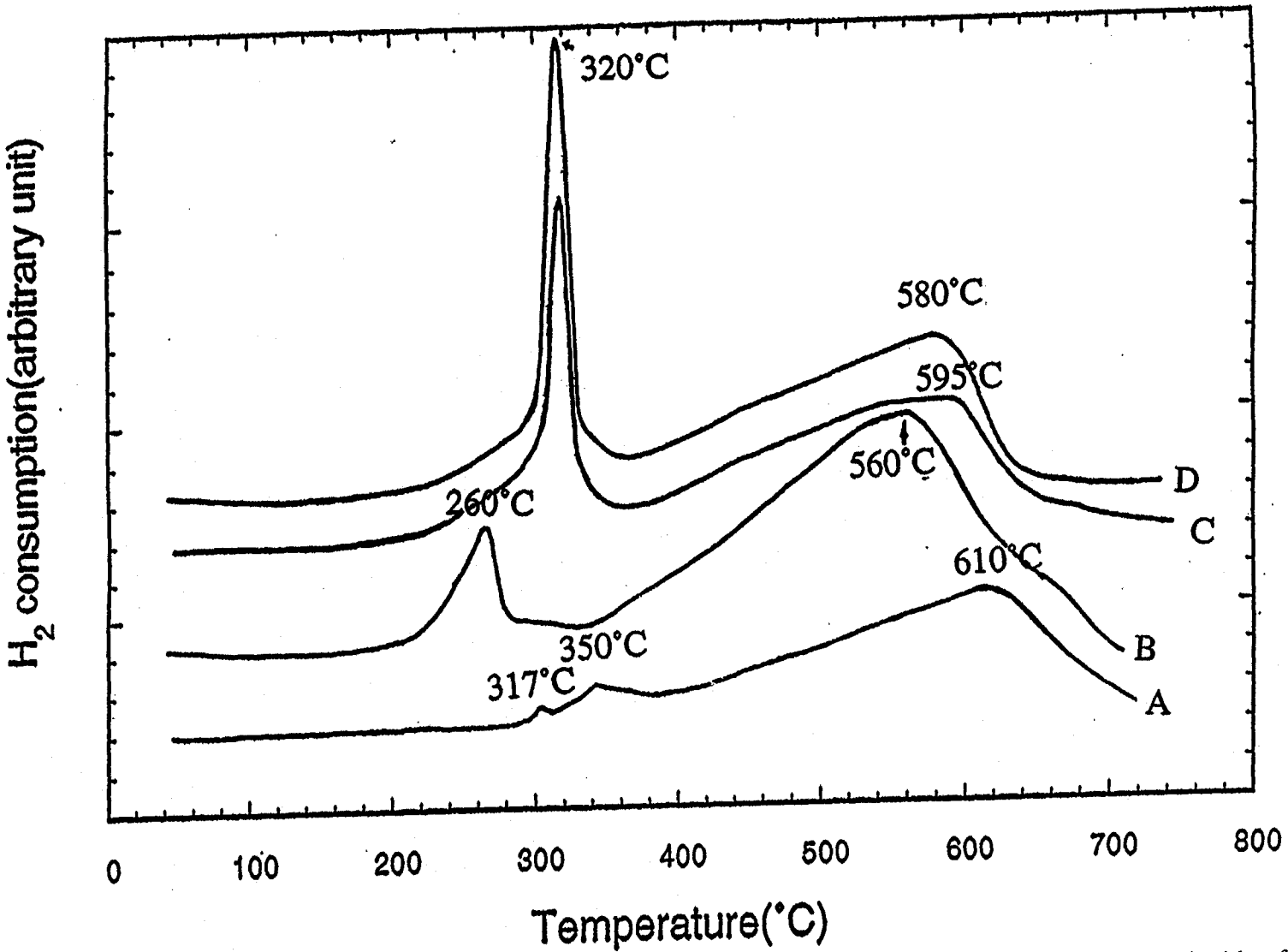

Figure 20. Effect of silica, potassium and calcium oxide addition on the TPR profiles of iron catalyst promoted with a fixed amount of copper at 3 parts. The catalysts are precalcined at 300°C, 5 h: (A) 100 Fe/3 Cu/4 K/6 Ca/16 SiO_2; (B) 100 Fe/3 Cu ; (C) 100 Fe/3 Cu/16 SiO_2 and (D) 100 Fe/3 Cu/4 K/16 SiO_2.

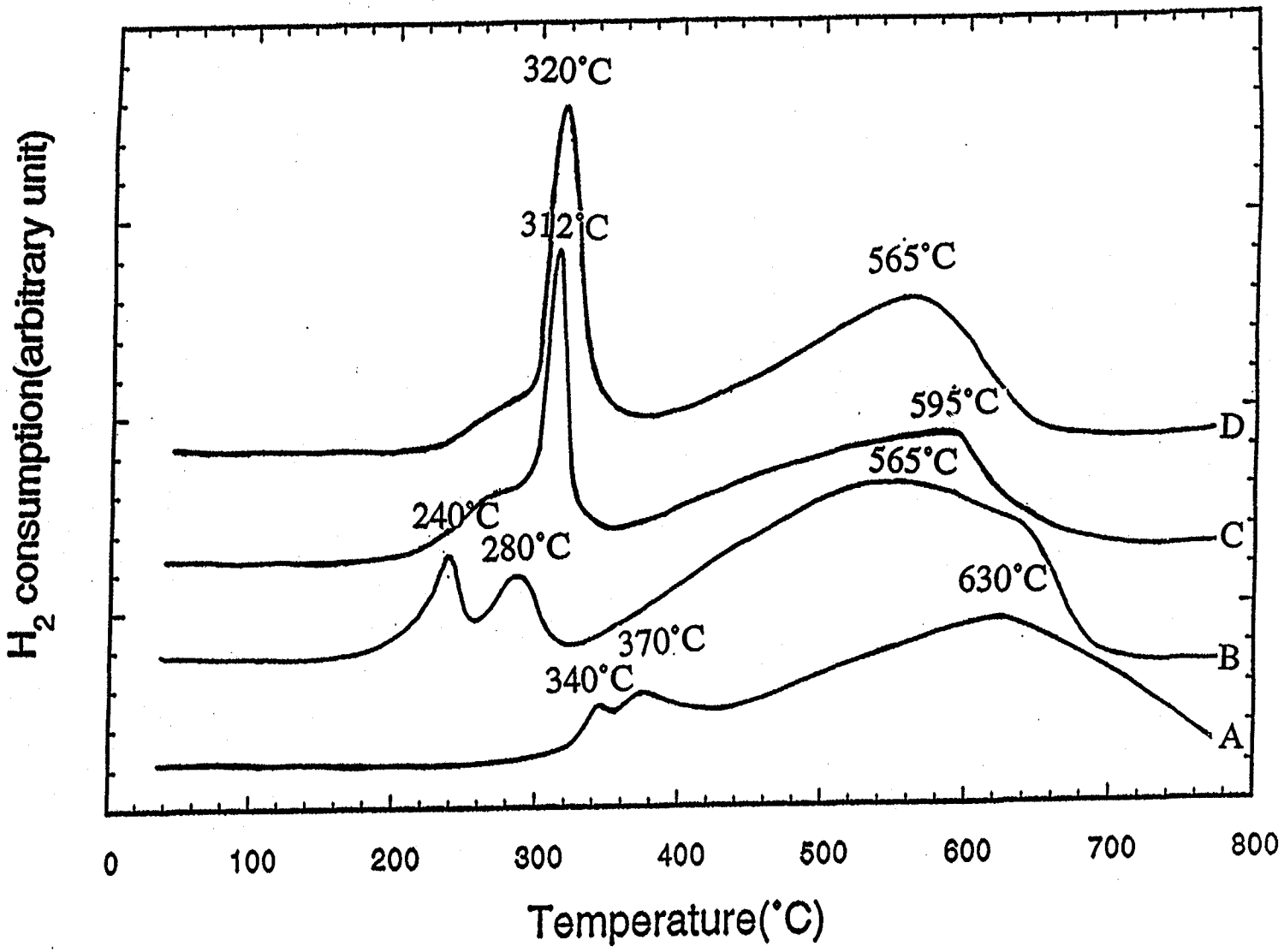

Figure 21. Effect of silica, potassium and calcium oxide addition on the TPR profiles of iron catalyst promoted with 5 parts of copper. All the catalysts are precalcined at 300°C, 5 h: (A) 100 Fe/5 Cu/6 K/6 Ca/24 SiO_2; (B) 100 Fe/5 Cu; (C) 100 Fe/5 Cu/24 SiO_2 and (D) 100 Fe/5 Cu/6 K/24 SiO_2.

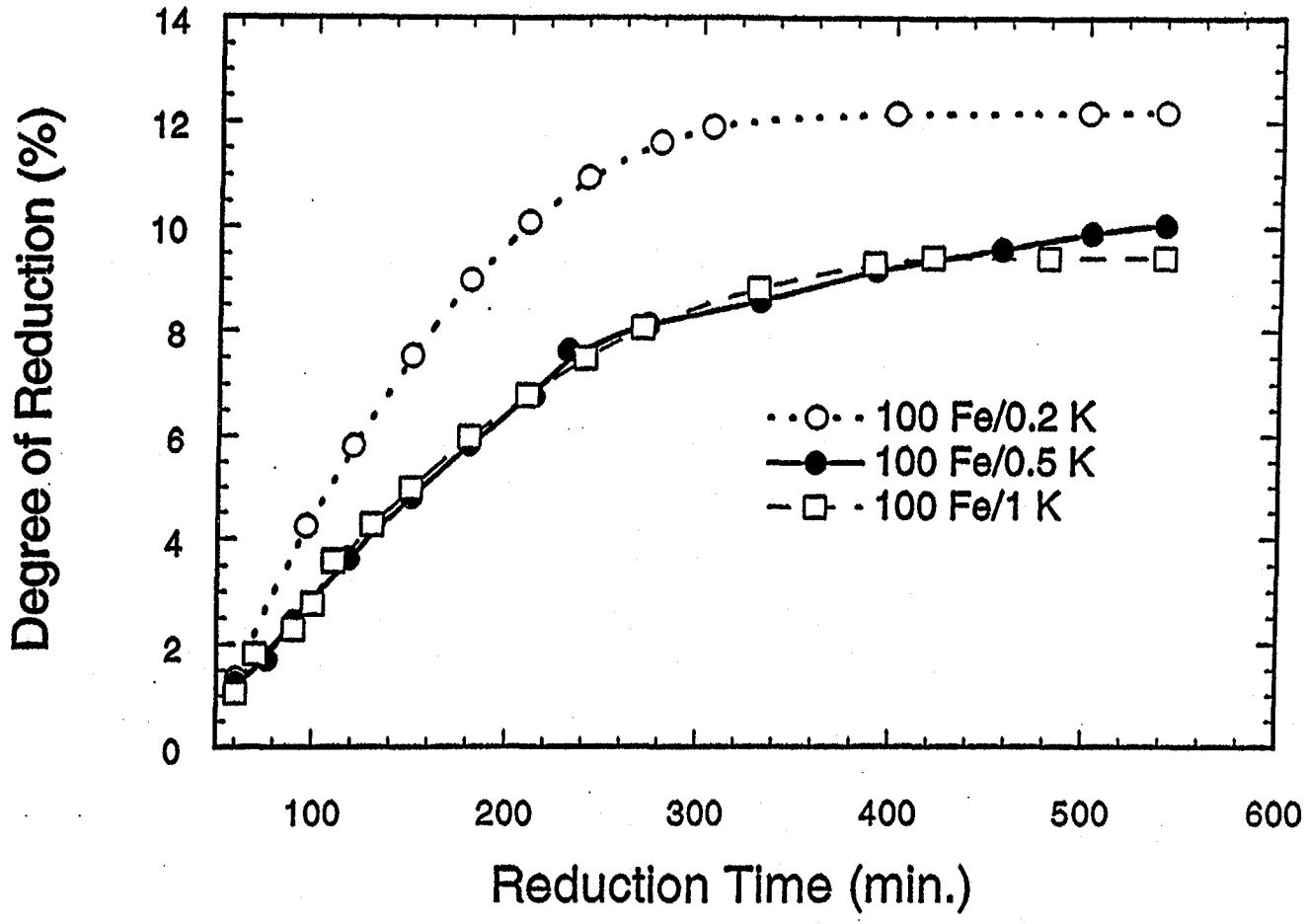

Figure 22. Effect of potassium addition on the degree of reduction of iron catalysts as a function of reduction time under isothermal conditions at 280°C in 5%H_2/95%N_2 (determined using TPR apparatus, rate = 40 ml/min, ramp = 20°C/min until 280°C and maintained at this temperature for 8 h).

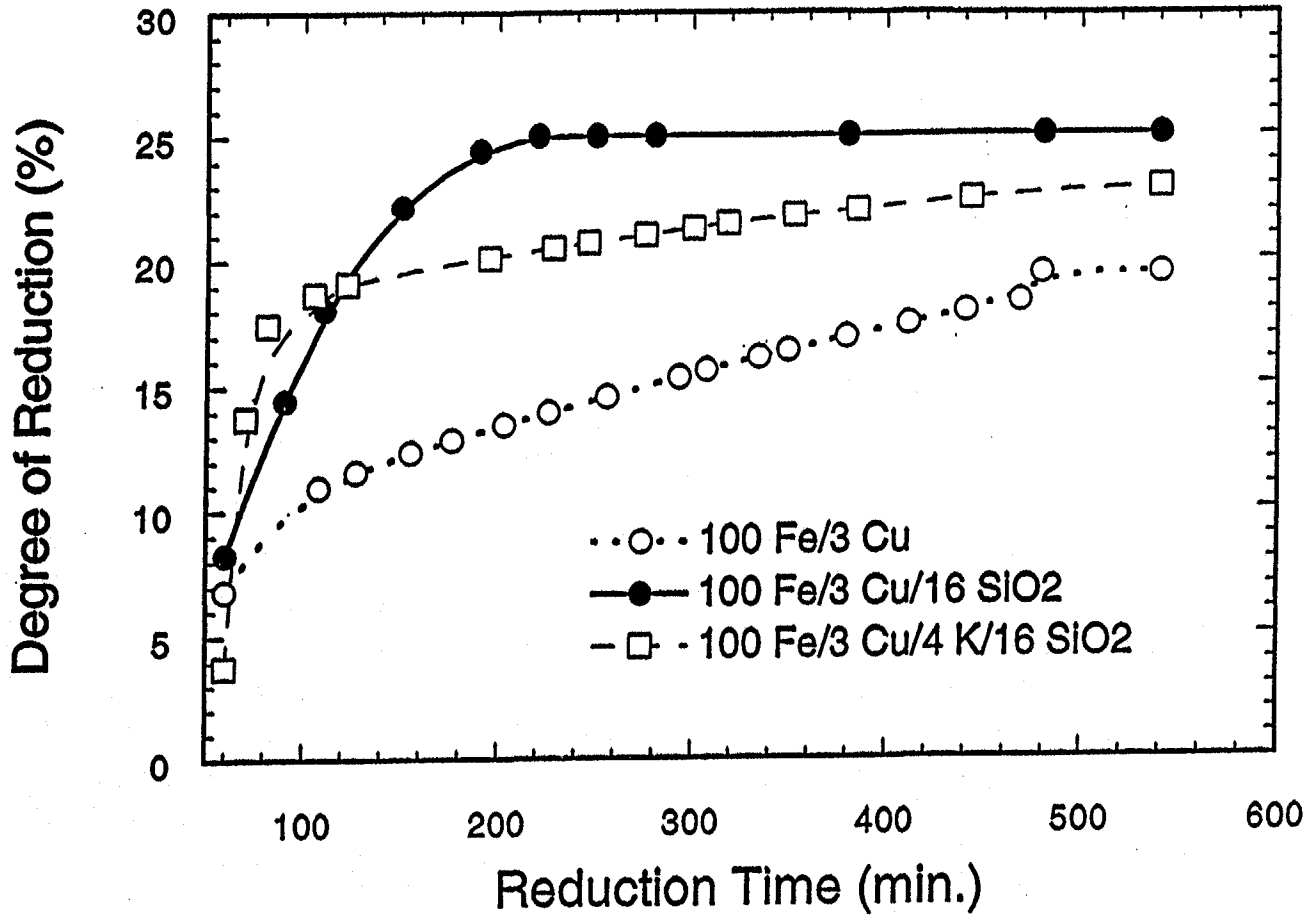

Figure 23. Effect of silica and potassium addition on the degree of reduction of iron catalyst promoted with 3 parts of copper as a function of reduction time under isothermal conditions at 280°C in 5%H_2/95%N_2 (determined using TPR apparatus, rate = 40 ml/min, ramp = 20°C/min until 280°C and maintained at this temperature for 8 h).

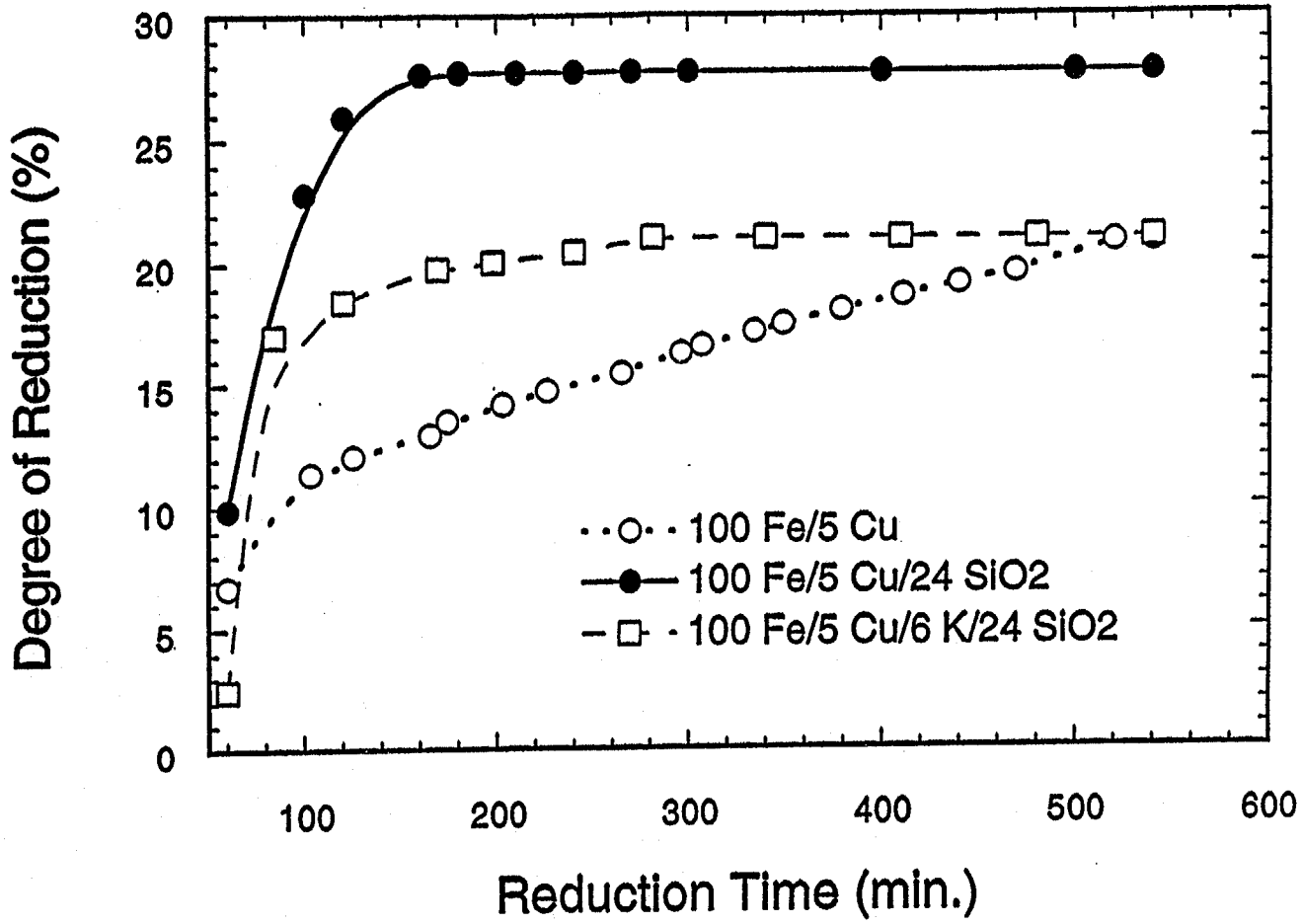

Figure 24. Effect of silica and potassium addition on the degree of reduction of iron catalyst promoted with 5 parts of copper as a function of reduction time under isothermal conditions at 280°C in 5%H_2/95%N_2 (determined using TPR apparatus, rate = 40 ml/min, ramp = 20°C/min until 280°C and maintained at this temperature for 8 h).

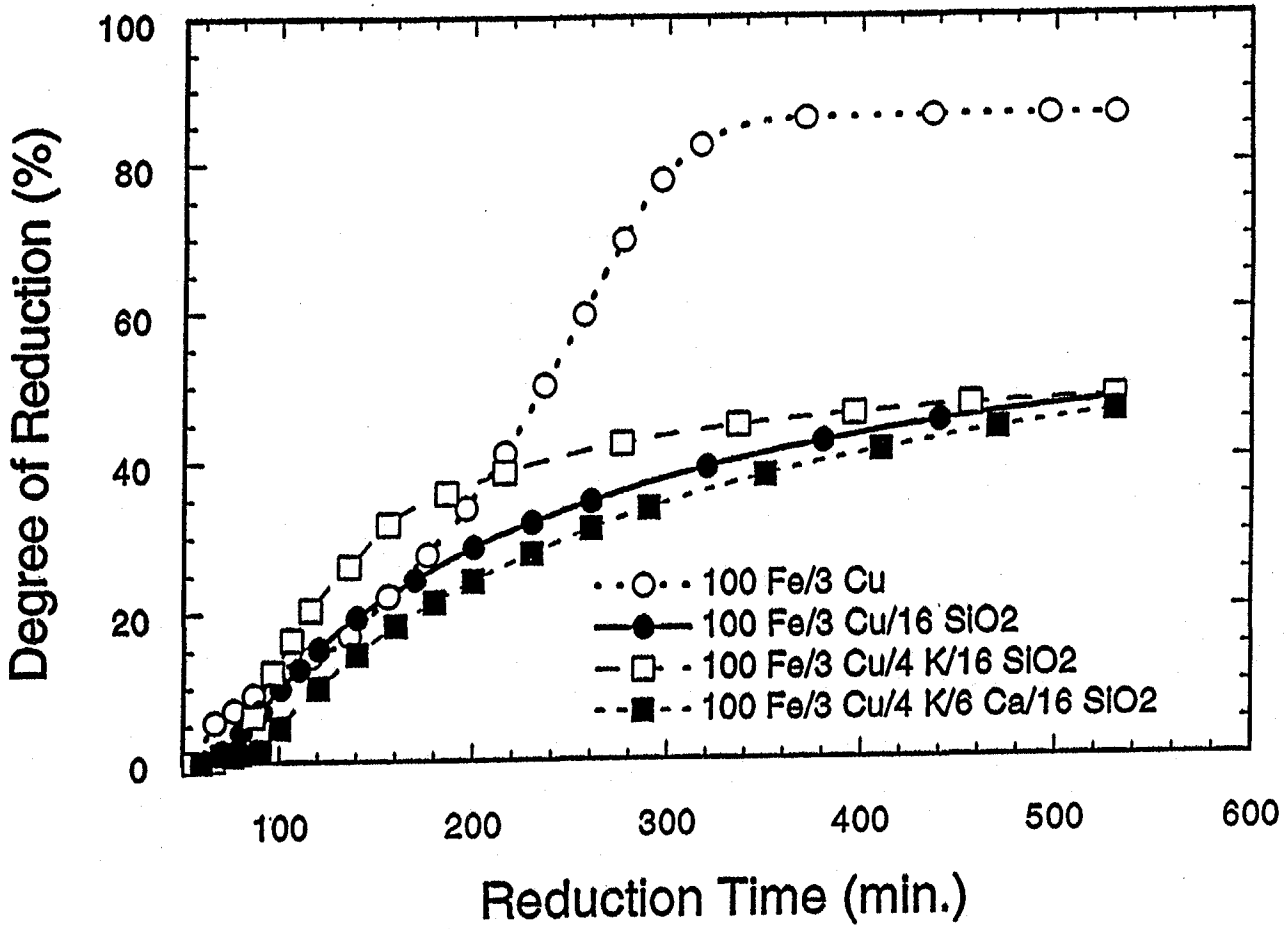

Figure 25. Effect of potassium, calcium, and silica addition on the degree of reduction of iron catalyst promoted with 3 parts of copper as a function of reduction time under isothermal conditions at 280°C in H_2 (determined by TGA at a flow rate = 40 ml/min, ramp = 5°C/min until 280°C).

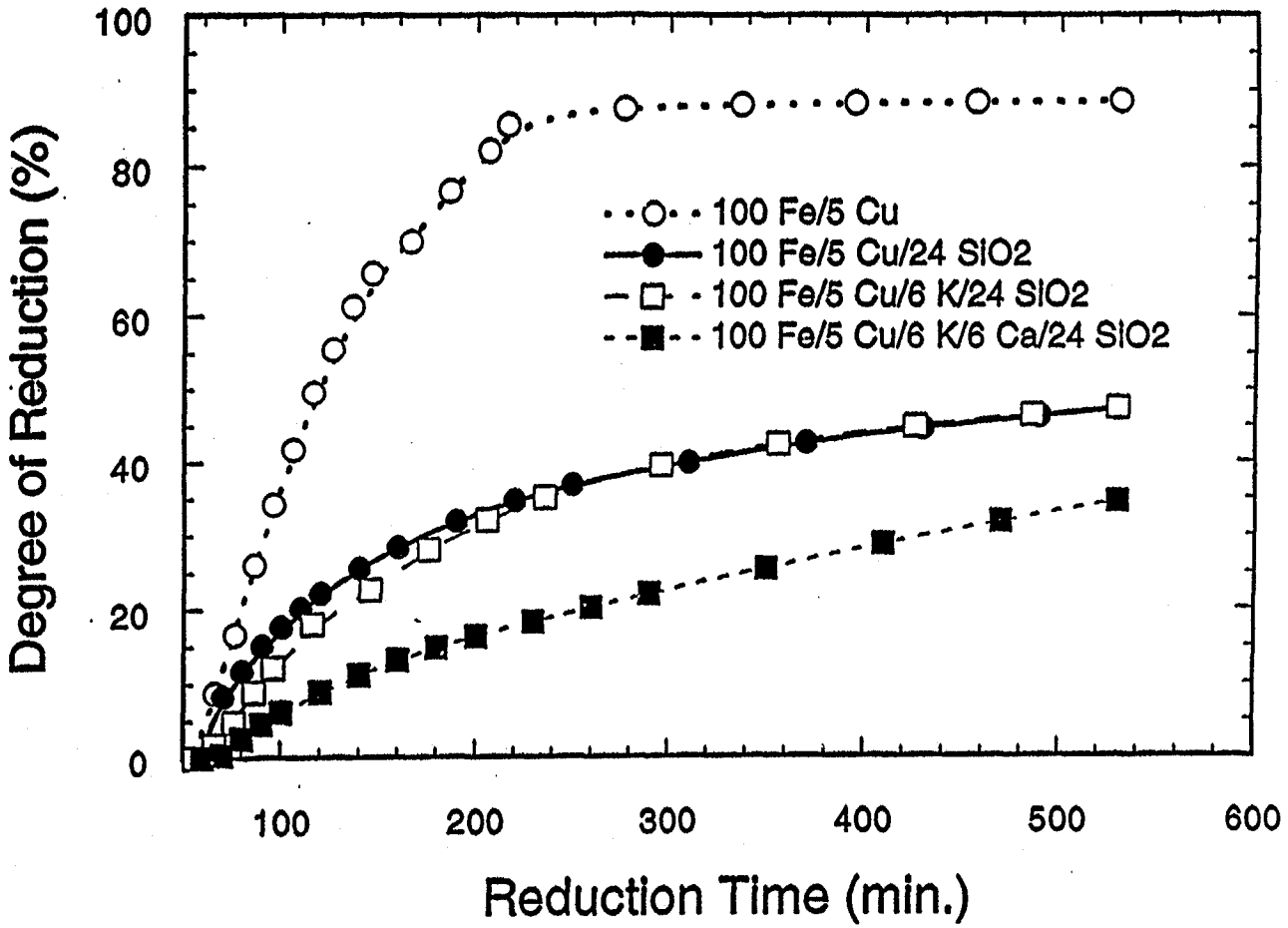

Figure 26. Effect of potassium, calcium, and silica addition on the degree of reduction iron catalyst promoted with 5 parts of copper as a function of reduction time under isothermal conditions at 280°C in H_2 (determined by TGA at a flow rate = 40 ml/min, ramp = 5°C/min until 280°C).