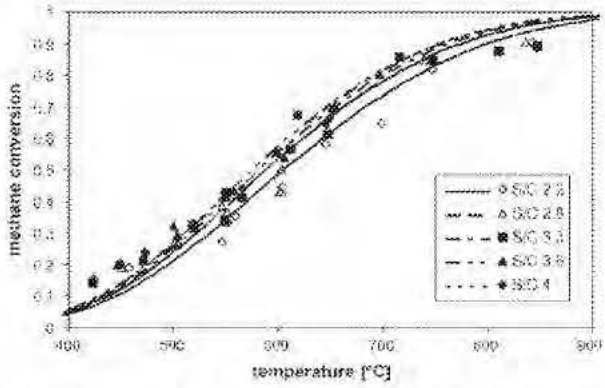


**Fig. 2.** Methane conversion as function of temperature for varying S/C in SR of methane (catalyst with 600 cpsi); symbols: experiment; lines: model predictions.

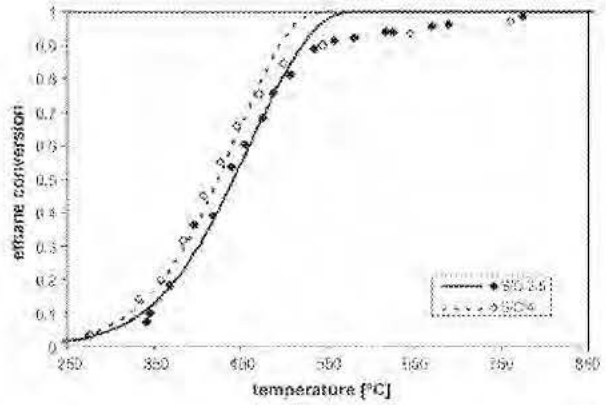


**Fig. 4.** Ethane conversion as function of temperature for varying S/C in SR of ethane (catalyst with 900 cpsi); symbols: experiment; lines: model predictions.

In the equations $X_i$ is the conversion of species $i$, $S_p$ the selectivity of product $p$ ($CH_4$ is product in SR of higher alkanes and natural gas), $P_p$ the yield of product $p$, $y_i$ the mass fraction and $x_i$ the mole fraction of species $i$ in the product stream.

### 5.1. Methane feed

The experiments using methane and water as feed cover a temperature range of 400–850 °C, six S/C ratios ranging from 2.2 to 4 were studied on a catalyst with 600 cpsi. The conversion increases with increasing S/C (Fig. 2). 50% of methane is converted at 600 and 630 °C for S/C 4 and 2.2, respectively. At low temperatures up to 450 °C no CO is produced, all methane converted is totally oxidized to $CO_2$. With increasing temperatures the CO selectivity increases to 63.4% and 46.5% at 845 °C for S/C 2.2 and 4, respectively (Fig. 3).

### 5.2. Ethane feed

For the experiments using the higher alkanes and natural gas as feed stock only two S/C ratios (2.5 and 4) have been examined. For SR of ethane, conversion starts at temperatures exceeding 250 °C (Fig. 4). Conversion above 90% is achieved for temperatures above 550 °C. In case of S/C 2.5, the temperature at which a given conversion is observed is approximately 25 °C lower than in case of S/C 4. CO is the main product at high temperatures (S/C 4 above 900 °C, S/C 2.5 above 700 °C), for both S/C's the selectivity for the formation of $CO_2$ reaches a maximum at about 580 °C, while methane is only produced at low temperatures (40% selectivity at 450 °C).

### 5.3. Propane feed

As in SR of ethane, conversion of propane occurs at temperatures exceeding 250 °C, and the conversion exceeds 90% at temperatures above 500 °C (Fig. 5). Like in SR of ethane the conversion at S/C 4 occurs at 25 °C lower temperatures than in case of S/C 2.5. The selectivity for the formation of methane (up to 40%) exhibits a maximum at temperatures between 400 and 500 °C (Fig. 6). $CO_2$ has a local minimum in this temperature range (selectivity of 44.8% and 55.4% for S/C 2.5 and 4, respectively) and reaches a maximum of 69% selectivity at ~600 °C. At higher temperatures, its selectivity decreases again Products of dehydrogenation reactions or coupling reactions were only observed in traces at temperatures above 800 °C.

### 5.4. Butane feed

The experimental data for SR of butane show that conversion starts at 300 °C and is complete for temperatures exceeding 600 °C conversion (Fig. 7). The conversion at S/C 2.5 equals the conversion at S/C 4 for 30 °C lower temperature. The behavior of selectivity is similar SR of ethane and propane.

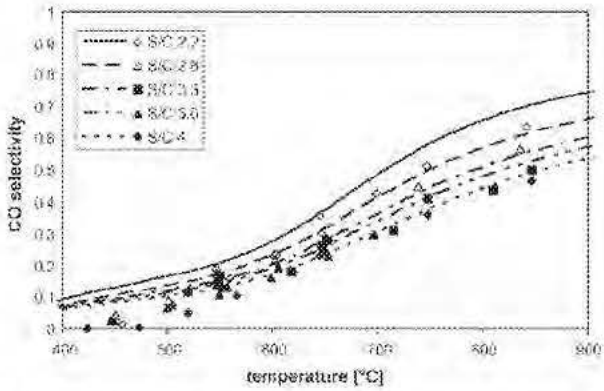


**Fig. 3.** CO selectivity as function of temperature for varying S/C in SR of methane (catalyst with 600 cpsi); symbols: experiment; lines: model predictions.

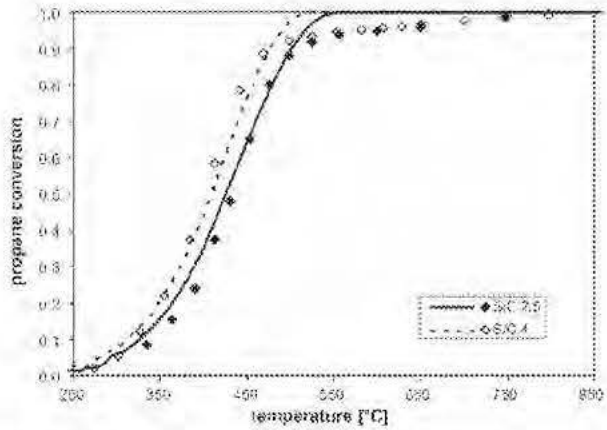


**Fig. 5.** Propane conversion as function of temperature for varying S/C in SR of propane (catalyst with 900 cpsi); symbols: experiment; lines: model predictions.