**Supplementary material for “Natural Gas and Hydrogen Blending: A Perspective on Numerical Modeling and CFD Analysis for Transient and steady-state scenarios”**

Tables S1 & S2 represent the data for the grid independence studies for the Crank-Nicolson Implicit scheme using MATLAB. At first time step, Δt is fixed at 100s and the no of nodes i.e. Δx is varied between 5-500m. The value of outlet pressure is recorded at 0s, 36000s and 86400s. the grid became stable at 200 nodes i.e Δx= 500m with minimum absolute error. The data for the same is represented in Table 1. After determining no of nodes, the analysis is carried for fixing the time step value. For Δx=500m, the time step value is varied between 10-200s. The value of outlet pressure is recorded at 0s, 36000s and 86400s. The time step of 20s is chosen as the natural gas and hydrogen are volatile gases and absolute error observed is small for this value. Thus the solution is converged at Δx= 500m, and Δt=20s.

Table S1: Data for fixing the no of nodes

|  |  |  |  |
| --- | --- | --- | --- |
| Time step=100 sec | P(x=L) in MPa | P(x=L) in MPa | P(x=L) in MPa |
| No of nodes | t=0s | t=36000s | t=86400s |
| 5 | 4.4988 | 4.4615 | 4.3889 |
| 10 | 4.4938 | 4.4485 | 4.36 |
| 20 | 4.4913 | 4.4188 | 4.3469 |
| 50 | 4.4898 | 4.327 | 4.3539 |
| 100 | 4.4893 | 4.2464 | 4.3527 |
| 120 | 4.4928 | 4.2396 | 4.3521 |
| 140 | 4.4891 | 4.2285 | 4.3418 |
| 160 | 4.4891 | 4.2271 | 4.3361 |
| 180 | 4.4891 | 4.2285 | 4.3309 |
| 200 | 4.489 | 4.2319 | 4.3263 |
| 250 | 4.489 | 4.2444 | 4.3179 |
| 300 | 4.489 | 4.259 | 4.3134 |
| 350 | 4.4889 | 4.2736 | 4.3121 |
| 400 | 4.4889 | 4.2873 | 4.3128 |
| 450 | 4.4889 | 4.2997 | 4.3149 |
| 500 | 4.4889 | 4.3111 | 4.318 |

Table S2: Data for fixing the time step value

|  |  |  |  |
| --- | --- | --- | --- |
| No of nodes=200 | P(x=L) in MPa | P(x=L) in MPa | P(x=L) in MPa |
| Time step value  | t=0s | t=36000s | t=86400s |
| 10 | 4.489 | 4.4106 | 4.3417 |
| 20 | 4.489 | 4.3499 | 4.3488 |
| 40 | 4.489 | 4.2662 | 4.3551 |
| 60 | 4.489 | 4.2335 | 4.3471 |
| 80 | 4.489 | 4.2269 | 4.3359 |
| 100 | 4.489 | 4.2319 | 4.3263 |
| 120 | 4.489 | 4.2417 | 4.3194 |
| 160 | 4.489 | 4.2651 | 4.3129 |
| 180 | 4.489 | 4.2766 | 4.3124 |
| 200 | 4.489 | 4.2874 | 4.3132 |