**Real-time forecasting of key coking coal quality parameters using neural networks and artificial intelligence**

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**Appendix B. The definition of the input parameters used in the CSR calculation formula.**

N6 = -1.06088 + N14\*0.54428 + N20\*0.475002

N14 = -1.83297 + N450\*N29\*0.0402671 - N450^2\*0.0241468 + N29\*1.21399 - N29^2\*0.0190778

N450 = -58.099 + N611\*0.679282 + N640\*2.26935 - N640^2\*0.0156912

N640 = -11.3778 + S\*142.152 - S\*AD\*4.41323 - S^2\*57.4878 + AD\*3.78636

N5 = -1.50845 + N13\*0.553833 - N13\*N20\*0.000184158 + N20\*0.484319

N20 = 11.5459 + N731\*0.74737 + N731\*N52\*0.0397827 - N731^2\*0.0297391 - N52^2\*0.00908251

N52 = -4.34585 - N604\*0.374581 - N604\*N67\*0.0256647 + N604^2\*0.0177198 + N67\*1.40692 + N67^2\*0.00849793

N67 = -13.7311 - N127\*N151\*0.215896 + N127^2\*0.114861 + N151\*1.47657 + N151^2\*0.0967414

N127 = 32.9596 - N673\*0.111777 - N673^2\*0.00595433 + N268^2\*0.0146761

N268 = -57.1126 + N424\*2.11421 - N424^2\*0.0133305 + N462\*0.948582 - N462^2\*0.00448375

N462 = -59.0603 + N602\*1.48047 - N602\*N729\*0.0135992 + N729\*1.35164

N673 = 110.256 + B\*QIA\*9.14967e-06 - B^2\*0.00103421 - QIA^2\*6.22519e-08

N604 = 12.8452 + N758\*N760\*0.0138226

N760 = 17.4354 + SI\*A\*0.169175

N758 = 709.853 + DA\*RO\*796.152 - DA^2\*318.957 - RO\*1129.03

N731 = 47.7581 + AA\*2.60312 - RI\*0.959502 + RI^2\*0.0113479

N13 = -1.81362 + N449\*N29\*0.0404473 - N449^2\*0.0242508 + N29\*1.21282 - N29^2\*0.0191401

N29 = -3.95927 - N62\*N120\*0.066054 + N62^2\*0.0385499 + N120\*1.08909 + N120^2\*0.0270186

N120 = 2.25675 - N249\*3.59314 + N249^2\*0.035102 + N217\*4.45813 - N217^2\*0.033413

N217 = 31.2017 + N276\*1.32515 - N276\*N544\*0.0472938 + N276^2\*0.0261066 - N544\*1.44571 + N544^2\*0.0306442

N544 = -28.2988 + N593\*2.3783 - N593\*N788\*0.0153618

N788 = -19.2343 + N827\*1.2411 - N827^2\*0.0045741 + N838^2\*0.00653412

N838 = -2551.48 - M\*2.1304 + M^2\*0.146235 + QIA\*0.166071 - QIA^2\*2.63326e-06

N827 = -2.10124 + VF\*A\*0.073722 + A\*1.20447 - A^2\*0.0301846

N593 = 16.5793 + N720\*N759\*0.0125487

N759 = -11.4582 + A\*2.3334 + A\*AD\*0.132221 - A^2\*0.0337049 + AD\*3.1487 - AD^2\*0.337334

N720 = 41.2688 + B\*0.320397 - B^2\*0.00106683

N276 = -53.9316 + N424\*2.08173 - N424^2\*0.0126538 + N487\*0.829495 - N487^2\*0.00353783

N487 = -61.2773 + N666\*2.33986 - N666^2\*0.0150584 + N729\*0.628315

N729 = 8.91462 + PA\*454.7 - PA\*A\*7.81557 - PA^2\*557.85 + A\*1.31497

N666 = -0.0192156 + S\*146.013 - S^2\*76.5319

N249 = -66.7173 + N423\*1.03412 - N423^2\*0.0044665 + N424\*2.43202 - N424^2\*0.0173058

N424 = 92.8975 + N611^2\*0.00842984 - N777\*3.23219 + N777^2\*0.0367668

N423 = 66.393 + N519\*2.05704 - N519\*N777\*0.018958 - N519^2\*0.00126838 - N777\*3.98179 + N777^2\*0.0506964

N519 = 6.27584 + PA\*245.152 - PA\*S\*171.052 - PA^2\*317.04 + S\*107.544 - S^2\*47.7589

N62 = -17.7229 + N151\*1.63875 - N151\*N199\*0.13586 + N151^2\*0.0569973 + N199^2\*0.0730301

N199 = 29.4862 - N701\*N270\*0.0111818 + N270^2\*0.0189581

N270 = -46.8326 + N426\*2.12905 - N426^2\*0.0137117 + N452\*0.511413

N452 = -65.7086 + N603\*1.82397 - N603\*N690\*0.0134143 - N603^2\*0.00401524 + N690\*1.35005

N690 = -224.778 + DA\*204.094 - DA\*PA\*1340.7 + PA\*2000.09 - PA^2\*463.831

N603 = -34.2783 + S\*135.767 - S^2\*70.9464 + A\*1.64234 - A^2\*0.0108882

N426 = 93.0553 + N611^2\*0.00847421 - N782\*3.24234 + N782^2\*0.0368631

N782 = 41.2067 - CL\*282.457 + CL^2\*712.309 + AD\*8.6392 - AD^2\*0.456969

N701 = 60.8771 + N808^2\*0.00708699 - N818\*1.87502 + N818^2\*0.0245208

N818 = 28.0774 - L\*0.923473 + AA\*7.77554 - AA^2\*0.388089

N808 = -211.786 + RO\*169.365 - RO\*RI\*2.72314 + RI\*4.15021

N151 = 213.42 - N848\*6.26992 + N848^2\*0.0488653 + N297^2\*0.0117238

N297 = -38.9717 + N431\*1.19593 - N431\*N456\*0.0109254 + N456\*1.13267

N456 = 44.2725 + N689\*2.7011 - N689\*N777\*0.0321271 - N777\*4.06766 + N777^2\*0.059538

N777 = 40.6907 + AA\*8.88841 - AA^2\*0.47686 - CL\*283.381 + CL^2\*715.096

N689 = 79.0406 - I\*1.37557 + I\*PA\*5.87871 + I^2\*0.0121688 - PA^2\*313.396

N431 = -33.8029 + N602\*2.0641 + N602\*N611\*0.0146466 - N602^2\*0.0207438 - N611^2\*0.0015572

N602 = -384.576 + DA\*295.271 - DA\*S\*325.679 + S\*556.414 - S^2\*62.4201

N848 = 24.6027 + VF^2\*0.0595947

N449 = -57.6176 + N611\*0.677629 + N631\*2.25262 - N631^2\*0.0155201

N631 = -11.6072 + AA\*3.89412 - AA\*S\*4.54173 + S\*142.055 - S^2\*57.0549

N611 = 148.496 + B\*VF\*0.0224745 - B^2\*0.00169359 - VF\*5.20806