Part II: Setting up a Solver Block

In Part I of the solver-block ProTips series, different application scenarios of a Solver Block were shown; however, the details of the actual solver setup are quite important to understand. This issue of ProTips discusses the different mathematical solution methods in more detail and walks through the dialog for setting up a solver.

Going back to the first example in Part I, the plant engineer in an amine unit wants to know what solvent flowrate would be needed to meet the treated gas specification.
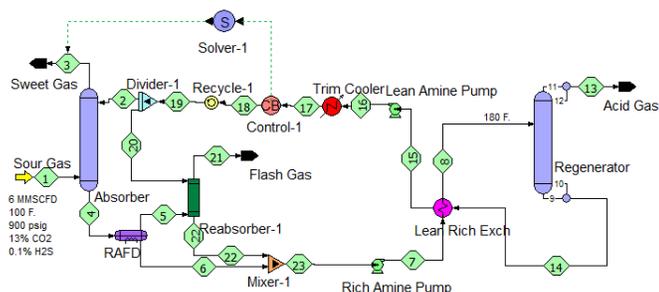

Figure 1 – Flowsheet for determining flowrate to meet treated gas specification

As discussed in Part I, the Solver Block takes an Adjust Variable specification from a block, in this case the Control Block, and the user provides the lower and upper limits of the Adjust Range as illustrated in Figure 2.
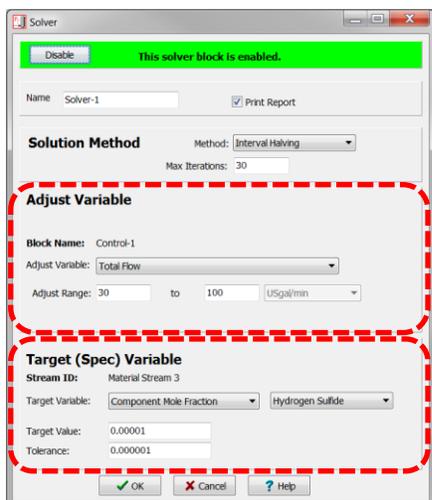

Figure 2 – Solver Dialog box, Adjust Variable Inputs

Once the Adjust Variable data have been entered, the Target (Spec) Variable needs to be specified. The Target Variable is a stream result, in this case the mole fraction of H_2S in Stream 3, i.e., the sweet gas leaving the absorber. The allowable error tolerance must also be provided. In the Solver Block, Error Tolerance is the <u>actual</u> error (Actual Value – Target Value). For instance, in the example shown in Figure 2, the target H_2S mole fraction is 10^{-6} (1 ppmv). The Error Tolerance is 10^{-7} mole fraction (0.1 ppmv). This means the Solver Block will achieve a target value of 1ppmv ± 0.1ppmv.

There are three solution methods currently available in ProTreat® – interval halving, linear interpolation, and quadratic interpolation. Interval halving is a slower method compared to the others; however, if the target spec can be met within the user-specified upper and lower bounds, it is guaranteed to find the solution given enough iterations. Linear interpolation may be slightly faster than interval halving, especially for cases where the relationship between the adjust variable and target spec is fairly linear in nature. Quadratic interpolation is the fastest solution method for cases where the relationship may be either linear or non-linear. Picking the right solution method may not always be a clear choice. *A priori* understanding of the relationship between the adjusted variable and target spec will be useful in deciding the solution method. If no *a priori* information exists, interval halving is the safest choice.

Once all fields of the dialog box have been filled and the flowsheet begins to solve, the Solver will take over at the appropriate position in the sequence and iteratively manipulate the designated Adjust Variable until the Target Variable is within the specified Tolerance.

PROTIP: If you are unsure of the upper and lower bounds, it is good practice to manually check them by disabling the solver and inputting the upper and lower bound values into the target block to ensure the solution lies between them. The two ways of disabling a Solver Block are by the "Disable" button at the top of the dialog box, or by selecting the Solver, right-clicking, and selecting "Disable" in the dropdown list.

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