**Highlights**

- The sparse matrix bipartitioning problem for an equal number of nonzeros is NP-complete.

- An improved exact branch-and-bound bipartitioning algorithm is presented.

- The improvement is obtained by stronger flow-based and packing bounds.

- 839 matrices from the SuiteSparse matrix collection have been solved to optimality.

- The new matrix partitioner MP is 13.8 times faster than the MondriaanOpt partitioner.