Line Balancing of an Integrated Pyroprocessing Using IOMP

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1. Introduction

The Korea Atomic Energy Research Institute (KAERI) has been developing the multi-purpose integrated pyroprocessing operation model [1]. The model is based on the implementation of the dynamic material flow. The model of a so-called 'Integrated Operation Model for Pyroprocessing (IOMP)' is expected to provide an intuitive and various interfaces to facilitate user's access and comprehensive understanding of the complicated integrated pyroprocessing technology, and to enable users to analyze in-depth dynamic material flow [2,3]. IOMP v1 is available in KAERI and can be used to give insights into what optimized Integrated Pyroprocessing operation is by varying the various process parameters.

In this study, The IOMP will be introduced briefly, and case study will be presented by attempting line balancing analysis that can equalize capability values between unit processes.

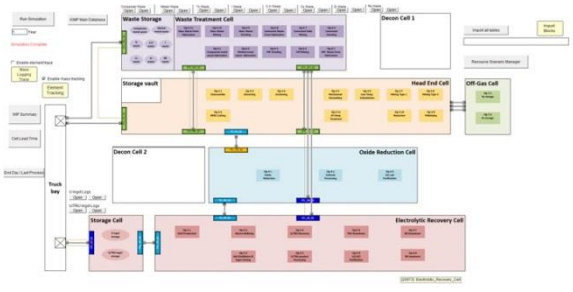

Fig. 1. 1st Level User Interface of IOMP.

2. Proposal for IOMP

2.1 Key Function

IOMP v1 can be used in various fields such as process control, safety measure and facility. The detailed functions of each field are as follows.

- Material transfer and operation tasks
- Element-wise material tracking
- Work-In-Progress(WIP) and hold-up analysis
- Periodic-and non-periodic operation handling
- Diversion scenario analysis
- Process operation scenario analysis

The IOMP shall include every unit process that KAERI's up-to-date pyroprocessing flow-sheet. The process parameters include the composition of Spent Nuclear Fuel (SNF) feed, process capacity, process time, the number of equipment, separation ratios, the number of human operators and material handling systems, and the size of WIP (Work In Process) storage.

2.2 Line Balancing of Integrated Process

One of the main function that the IOMP must have is operation analysis. The IOMP is capable of process line balancing analysis to design and efficient process line and give insight into the configuration of the process line. In order to design a well-balanced process line, a user might try to adjust the process time, process capacity, the number of process equipment and run a simulation. To check each cell lead time, data value will be investigated by clicking the [Cell Lead Time] or [IOMP Main Database-Report]. The lead time is defined as the time from the start of operation to completion. It is also possible to equalize the capabilities between unit processes.

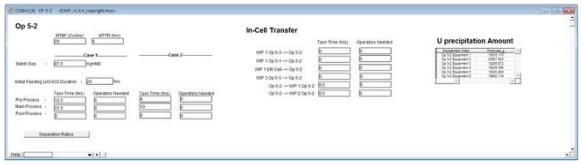

Fig. 2. Third level of window interface to adjust parameters and to display results.

2.3 Case study: Cell lead time analysis

In the process simulation operation, 72 assembly processing time is assumed to be 1 year and annual number of operation aims at 200 days. The simulation's initial value is recorded by engineering judgment. The initial setting data value about 1 year simulation run are as follows.

Table 1. Initial data of IOMP's default capacity value

Cell name	Lead time
Head End Cell	196.38
Oxide Reduction Cell	184.75
Electrolytic Recovery Cell	224.16
Storage cell	177.51
Waste Cell	242.95
Off-gas Cell	189.30

The data show that the Electrolytic Recovery (ER) cell is 244.16 days and the Waste cell is 242.95 days, which is more than 200 days. Therefore, the process line balancing is performed by adjusting the capacity of the corresponding cell. The batch size is doubled and the process task time is reduced by half for improving capacity. Capacity can be modified by importing or modifying the user-defined parameters in the 'IOMP import parameters' EXCEL file or directly from the Third Level window of the user interface. Table 2 Shows the simulation results after using the modified parameters.

Table 2. Result data of adjusted capacity value

Cell name	Lead time
Head End Cell	196.38
Oxide Reduction Cell	184.75
Electrolytic Recovery Cell	176.92
Storage cell	173.00
Waste Cell	187.65
Off-gas Cell	189.30

As a result of adjusting the capacity of ER cell and Waste cell, the target standard value was achieved for 200 days a year.

3. Conclusion

The IOMP v1 was developed at KAERI to present the engineering development direction of integrated pyroprocessing technology. The IOMP can propose insights of what is optimized integrated pyroprocessing operation while providing multiple interfaces and changing process parameters. It is possible to perform various analyzes such as equilibrium concentration analysis, logistics analysis, and scenario change analysis of operating conditions.

In this study, IOMP was used to analyze process line balancing. Integrated pyroprocessing aims at 200 days of operation per year, and the initial process capability of the model is set by engineering judgment. However, the lead time of each process cell is analyzed, and ER cell and Waste cell exceed 200 days. Therefore, in order to improve the capacity of each cell, the process task time is reduced by half and the batch size is doubled to change the parameters and attempt line balancing. As a result, efficient process line balancing, which achieved the annual 200 day operating target, was analyzed.

REFERENCES

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