Application of Sub Matrixes for Phase Process Optimization of Linear Programming

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The problem of optimization of a multiphase production process by the linear programming method is very frequent in manufacturing practice. Instead of a classical solution to the problem, by creating constraint equations per production phase, the paper proposes the methodology of application of sub matrixes for solving the complex mathematical model of the problem in a matrix form.

The method is illustrated in the example of an optimization process of manufacturing and assembly of a hydraulic valve for regulation of pressure and flow, which is intended for installation on hydraulic bar feeders for CNC machines. Problem is solved by MatLab software package.

Keywords: Phase process, linear programming, optimization, sub matrixes

1. INTRODUCTION

In contrast to the single-phase production process in which the final products are directly produced from semi-finished products, multiphase process can be divided into several single-phase processes, interrelated and conditioned by the given constraints.

The number of levels of multiphase process breakdown is determined by objective conditions such as technology production process and assembly of the product, although breakdown can sometimes be also due to subjective decisions [1] [2].

The paper [2] discusses programming of multiphase processes that can be mathematically solved by linear programming method. The procedure of forming a mathematical model to optimize multiphase process is present in the example of manufacturing and assembly of hydraulic valves for regulating pressure and flow, which is designed for installation on hydraulic feeders from rod material for CNC machines.

The task consists of the following procedure [2]: it is necessary to program the multi-phase production process in order to produce the optimal amount of control valves from available quantity of semi-finished product and standard parts while at the same time profit from the sale of the valve is maximum. Market limitations in the amount of product placement do not exist.

2. MATHEMATICAL MODEL

The mathematical model in its matrix form reads:
It is necessary to maximize the objective function:.

$$\max \mathbf{F}(\mathbf{X}) = \mathbf{d}\,\mathbf{X} \tag{1}$$

with satisfying the constraints with respect to available quantities:

$$\mathbf{M}\,\mathbf{X} \le \mathbf{B} \tag{2}$$

and the non-negativity condition:

$$\mathbf{X} \ge \mathbf{0} \tag{3}$$

For the given example [2], the matrices **M** , **X** and **B** read:

$$X = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \\ x_6 \\ x_7 \\ x_8 \\ x_9 \\ x_{10} \\ x_{11} \\ x_{12} \\ x_{13} \end{bmatrix} \qquad B = \begin{bmatrix} 10026,24 \\ 38,733 \\ 12,255 \\ 6,456 \\ 53,36 \\ 38,142 \\ 22,694 \\ 500 \\ 600 \\ 500 \\ 700 \\ 500 \\ 600 \\ 1000 \\ 700 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

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