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Chemical production and transportation optimization

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ABSTRACT

It is well known coal production and transport has been maintaining our production operations in important ways, the coal energy and reasonable production and transport, as well as energy efficiency improvements, and other issues are the hot spots. In this paper, coal production and transport problem is regarded as the research object, and the coal production problem is transformed into a transportation problem, then the transport problem is transformed into an optimization problem. Firstly, the northwest-corner method, smallest element method and Vogel method are respectively used to solve the problem, and several initial solutions are obtained, and they are analyzed and contrasted, then the result of Vogel method is chosen as a starting point optimization. Then, using closed loop method and the potential method to test and adjust the result, finally obtains the optimal scheme.

KEYWORDS

Chemical industry; Coal production; Generalized transportation problem; Transport price table.

INTRODUCTION

With chemical products widely used in daily life, the more important the chemical industry, chemical industry production problems at the same time has become the focus of attention. How to arrange production, enables enterprises to time and the amount of delivery, but also to achieve the lowest cost, which is not only the goal of each chemical companies, focus is academic research.

In addition to production scheduling problems, chemical companies also exist transport problems. For a long time our country's railway transport capacity can not meet the requirements of the development of the national economy, has become an obstacle to economic development and the bottleneck, especially for coal problem. In our case, the richest energy source is the

"Three West" region, and for the higher demand for energy coal Southeast is no bonanza. So rail transport would need to be transported to the enrichment of the resources needed to go more places. For efficient and convenient delivery, they had to build their own coal line. Currently, Shenhua group coal deliveries have about the Baoshen, Shensu, Suhuang, Dahuai -four lines, the total distance to reach 1368 km, and there are mines owned railway, etc. almost 1,500 kilometers. Now, it owns close to 500 locomotives, 25,000 trucks, and the cargo reached 300 million tons in 2010. Not only for the national economic construction has provided a guarantee and also on the entire surrounding economic development provides power.

Like this large enterprises have their own separate transport system is not a surprising thing, the Brazilian mining company Vale and other Fortune 500 companies are to have their own rail systems and ports, and even have 10,179 km of railways .So transport is as required for bulk energy companies to consider the issue, both in order to ensure the development of the national economy as a whole guarantees are an important exception. Therefore, in order to better assist national energy delivered, it is necessary to present the most up-to-date approaches blend into transporting coal.

Production scheduling problem is complicated, often can't find the optimal solution. Study on transportation issues has a long history, has developed a number of ways, are relatively simple. Production scheduling problems and transport problems, appears to be two separate issues, but the links between them. This article attempts to establish links between them,

Schedule the production problem into a transport problem, method of transport is used to optimize production scheduling problem.

RESEARCH METHODS

In order to explore the problem of minimizing the total freight volume, move some material from a number of transportation to several different places of origin, such problems are collectively referred to as transportation problems.

The transportation question earliest definition was American mathematician Hitchcock raises in 1941, but the related research might inquire into most early to 1781 French mathematician Gaspard Monge his related discussion. 1920-1930 year, former Soviet Union's mathematician A.N.Tolstoy has established the mathematical model in view of railway communication a series of questions, and first used to study transport scheme research of closed-loop method, linear programming-related issues has done pioneering work on the same Leonid Vitaliyevich Kantorovich transportation problem has made a significant contribution to the study, that transportation problems at the same time became known as the Mongolian Koch-Kantorovich transportation problem.

Transportation issue has been a hot topic, Jia Xiaoqiu[1] studied rough solid transportation problem under the environment, built the model, presented the algorithm. Zhang Chunmei[2] with an adaptive genetic algorithm for solving two-dimensional transportation issues guidelines .Sinan[3] proposed a computer algorithm transportation problem. Guo Qiang[4] proposed a new iterative algorithm transportation issues .Cheng Guozhong[5] put forward neural network method for solving transportation problem; Liu Xinwang[6] the study interval on the transport, established a model using fuzzy goal programming method for solving.

TRANSPORTATION CASE SOLUT-ION

Table1 Orders and production capacity table

Time	Order quantity	Production capacity	Cost of production
1	1400	1550	3.53
2	1350	1500	3.61
3	1260	1500	3.63
4	1340	1600	3.58
5	1700	1650	3.62
6	1650	1600	3.45

Here an analysis of the actual problem of coal production and transport .A coal producing coal production , which is arranged according to the needs of an enterprise to transport coal , but because of the relationship between production and demand , the output of each phase of its coal requirements are different .Per week can produce more coal as a preparation to post-production, however, all the previous production of coal must have inventory cost. In order to characterize the inventory cost convenient to set up every week is 0.2, then such a problem can be converted to a traditional transportation problem to solve. That is, one that will be a weekly production as a starting point, and each week's demand as a terminal, the originating point of the goods can be shipped to the first delivery point, as well as after, but each location of the freight, inventory costs, which has become a standard of transport problems. Orders and capacity table, are listed in the table below to make the lowest cost.

We use X_{ij} to denote the product quantity which is the number of delivery from the ith week to the jth week, in which $i = 1,2,3...6; i < j < 6$. So the unit cost of the production that is produced in the ith week and delivered in the jth week can be calculated according to the following table2.

Table2 Conversion transport table

Unit cost	1	2	3	4	5	6
1	3.53	3.53+0.2	3.53+0.4	3.53+0.6	3.53+0.8	3.53+1
2		3.61	3.61+0.2	3.61+0.4	3.61+0.6	3.61+0.8
3			3.63	3.63+0.2	3.63+0.4	3.63+0.6
4				3.58	3.58+0.2	3.58+0.4
5					3.62	3.62+0.4
6						3.45

(1) Due to the future of the total production is greater than the total order amount, the modeling should be taken into account on the virtual volume to a balance between production and marketing.

(2) In order to ensure the production and pay for a normal square, set the variable M, represents an infinite variables to describe the post- production can not meet those requirements previously obtained Table 3:

Table3 Generalized Transportation Problem Transport Price Table

Unit cost	B1	B2	B3	B4	B5	B6	B7	Pro
A1	3.53	3.73	3.93	4.13	4.33	4.53	0	1550
A2	M	3.61	3.81	4.01	4.21	4.41	0	1500
A3	M	M	3.63	3.83	4.03	4.23	0	1500
A4	M	M	M	3.58	3.78	3.98	0	1600
A5	M	M	M	M	3.62	3.82	0	1650
A6	M	M	M	M	M	3.45	0	1600
Sales	1400	1350	1260	1340	1700	1650	700	9400

In order to solve this problem, first use the Northwest corner method, the process is as follows

(1) According to the Northwest of graph matching, and then paddle have balanced rows or columns.

(2) The remaining part according to the first step method repeatedly until all trim with results so far.

Table4 Northwest corner method solving process table

Unit cost	B1	B2	B3	B4	B5	B6	B7	Pro	Bal
A1	3.53 (1400)	3.73	3.93	4.13	4.33	4.53	0	1550	150
A2	M	3.61	3.81	4.01	4.21	4.41	0	1500	1500
A3	M	M	3.63	3.83	4.03	4.23	0	1500	1500
A4	M	M	M	3.58	3.78	3.98	0	1600	1600
A5	M	M	M	M	3.62	3.82	0	1650	1650
A6	M	M	M	M	M	3.45	0	1600	1600
sales	1400	1350	1260	1340	1700	1650	700	9400	
Bal	0	1350	1260	1340	1700	1650	700		

The Northwest corner to act out the results:

Table5 Northwest corner method result table

Unit cost	B1	B2	B3	B4	B5	B6	B7
A1	1400	150					
A2		1200	300				
A3			960	540			
A4				800	800		
A5					900	750	
A6						900	700

After using the Northwest corner method, begin to consider using:
(1) First chooses in all costs smallest that to carry on a smallest element method line of assignment.
(2)After balancing to cross the line of a column, in the order before.

Table6 Smallest element method solving process table

Unit cost	B1	B2	B3	B4	B5	B6	B7	Pro	Bal
A1	3.53	3.73	3.93	4.13	4.33	4.53	0	1550	1550
A2	M	3.61	3.81	4.01	4.21	4.41	0	1500	1500
A3	M	M	3.63	3.83	4.03	4.23	0	1500	1500
A4	M	M	M	3.58	3.78	3.98	0	1600	1600
A5	M	M	M	M	3.62	3.82	0	1650	1650
A6	M	M	M	M	M	3.45	0 (700)	1600	900
sales	1400	1350	1260	1340	1700	1650	700	9400	
Bal	1400	1350	1260	1340	1700	1650	0		

The smallest element method to act out the results:

Table7 Smallest element method result table

Unit cost	B1	B2	B3	B4	B5	B6	B7
A1	1400					150	
A2		1350				150	
A3			1260			240	
A4				1340	50	210	
A5					1650		
A6						900	700

Then use the Vogel method.

1.Vogel method first to calculate the aberration and column difference, refers to the difference between each line in each column of the smallest number of two.
2.Then select the greatest aberration and the column number that corresponds to the difference in the minimum, according to the previous pattern matches.
3.Elimination matches with this line of the column and then repeats the process before until all selected values.

Table8 Vogel method solving process table

Unit cost	B1	B2	B3	B4	B5	B6	B7	Pro	Dif
A1	3.53	3.73	3.93	4.13	4.33	4.53	0	1550	3.53
A2	M	3.61	3.81	4.01	4.21	4.41	0	1500	3.61
A3	M	M	3.63	3.83	4.03	4.23	0	1500	3.63
A4	M	M	M	3.58	3.78	3.98	0	1600	3.58
A5	M	M	M	M	3.62	3.82	0	1650	3.62
A6	M	M	M	M	M	3.45	0	1600	3.45
sales	1400	1350	1260	1340	1700	1650	700	9400	
dif	M-3.53	0.12	0.18	0.25	0.16	0.37	0		

Since M is almost infinite value so this is the largest , followed by the minimum number of selected operations.

Table9 Vogel method solving process table 2

Unit cost	B1	B2	B3	B4	B5	B6	B7	Bal	Dif
A1	3.53 (1400)	3.73	3.93	4.13	4.33	4.53	0	150	3.73
A2	M	3.61	3.81	4.01	4.21	4.41	0	1500	3.61
A3	M	M	3.63	3.83	4.03	4.23	0	1500	3.63
A4	M	M	M	3.58	3.78	3.98	0	1600	3.58
A5	M	M	M	M	3.62	3.82	0	1650	3.62
A6	M	M	M	M	M	3.45	0	1600	3.45
Bal	0	1350	1260	1340	1700	1650	700	9400	
Dif	M-3.53	0.12	0.18	0.25	0.16	0.37	0		

The Vogel method to act out the results:

Table10 Vogel method result table

Unit cost	B1	B2	B3	B4	B5	B6	B7
A1	1400						150
A2		1350					150
A3			1260				240
A4				1340	50	50	160
A5					1650		
A6						1600	

According to three methods of analysis results are not the same, can discover the Northwest corner method approach results from the most simple and most likely not satisfactory, to the smallest element method to find that the result is optimized a bit but is still not very good. The Vogel method can be found in the choice of unit costs are minimal so imagine the end result certainly is minimal.Also needs to adopt the loop circuit method as well as the position potential method confirmation result for the result accuracy, as well as carries on the examination and the adjustment to the result. According to the previous analysis, the results of Vogel method is better, using the results to adjust Vogel law available tables:

Table11 Potential method test results table

Unit cost	B1	B2	B3	B4	B5	B6	B7	Pote
A1	1400						150	0
A2		1350					150	0
A3			1260				240	0
A4				1340	50	50	160	0
A5					1650			-0.16
A6						1600		-0.53
Pote	3.53	3.61	3.63	3.58	3.78	3.98	0	

Calculation of all non- basic variable number of test cells:

Table12 Potential method inspection table

Unit cost	B1	B2	B3	B4	B5	B6	B7	pote
A1	0	0.12	0.3	0.53	0.55	0.55	0	0
A2	M-3.53	0	0.18	0.43	0.43	0.43	0	0
A3	M-3.53	M-3.61	0	0.25	0.25	0.25	0	0
A4	M-3.53	M-3.61	M-3.63	0	0	0	0	0
A5	M-3.37	M-3.45	M-3.47	M-3.42	0	0	0.16	-0.16
A6	M-3	M-3.08	M-3.1	-3.03M	M-3.25	0	0.53	-0.53
pote	3.53	3.61	3.63	3.58	3.78	3.98	0	

From the validation of the results as you can see, each number is positive, indicates that any results will increase the total cost increase, but only starting from these results will not increase the cost of any, so to sum up the results are optimal. In the same way using the inspection results of several other results will cause overflow, the optimal algorithm is indeed optimal method.

CONCLUSIONS

This article has discussed the chemical industry production arrangement question, it abstract is the transportation question, and applied it the coal production system.Through the mathematical method of the specific coal production into an optimization problem, using a simple form to optimize the processing, respectively, using a variety of methods to make the calculation, finally get the optimal scheme of arrangement of coal production. The obtained result has the strong practice application value regarding the coal profession, also has provided the model for other chemical industry production arrangement.

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