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Research Article

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Multi-functional area design and simulation in the dangerous pharmaceutical enterprise

Yin Jing, Chen Nan and Meng xiangying

School of Mechanical-electronic and Automobile Engineering, Beijing Engineering Research Center of Monitoring for Construction Safety, Beijing University of Civil Engineering and Architecture, Beijing, China

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ABSTRACT

Focus on the dangerous pharmaceutical logistics center which integrate the function of production, logistics and marketing, the multi-functional area planning and design is taken into consideration in the paper. Based on the operation workflow description and quantity analysis, the plane layout and the spatial distribution are illustrated. Combined with the dynamic simulation on the platform of Flexsim, the relevant performance data is provided and the running effect can be seen at last.

Keywords: Dangerous pharmacy; Multi-functional area; Planning and design; Dynamic simulation; Flexsim

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INTRODUCTION

The chemical and pharmaceutical industry plays an important role in the people's livelihood which has developed rapidly in recent years. With fierce competition, many large-scale enterprises start to seek new effective operation mode and the comprehensive logistics center has been built up which integrates multiple functions of production, warehousing, packing and sales. Because of the more complex logistics structure presented and the special requirements for dangerous goods in the enterprises, it becomes crucial to make the efficient area planning and design that can contribute to reduce logistic costs and improve the working efficiency.

Since the Systematic Layout Planning method (SLP) is proposed, it has been applied to solving the problems of facility Layout design in practical [1]-[2]. At present, dynamic simulation technology is combined with SLP to do design and planning, by which more scientific and optimal scheme can be obtained [3]-[4]. In the paper, the problem of area planning in the logistics center is concerned, which has following characteristics:

(1) The planning object is a two-layer building in which multiple functions should be done, including production, warehousing, results and discussion, packing and sales and etc.
(2) With the background of chemical and pharmaceutical enterprises, the special requirements for dangerous goods are taken into consideration.

EXPERIMENTAL SECTION

1 LOGISTICS WORKFLOW ANALYSIS

With the data provided by the domestic large-scale chemical and pharmaceutical enterprise, from drugs into the receiving area, until finish goods waiting for delivery in the shipping area, the main process during this time is shown in figure 1. Firstly, the materials arrive in receiving area and are transported to warehouse waiting for production. Then after the raw material checking in the sampling room, it is sent back to the warehouse. After the raw material and the packaging material sent to production area and packaging area, the finish goods is palletized in the palletizing area. At last, the finish goods with pallet are waiting for delivery in the shipping area.

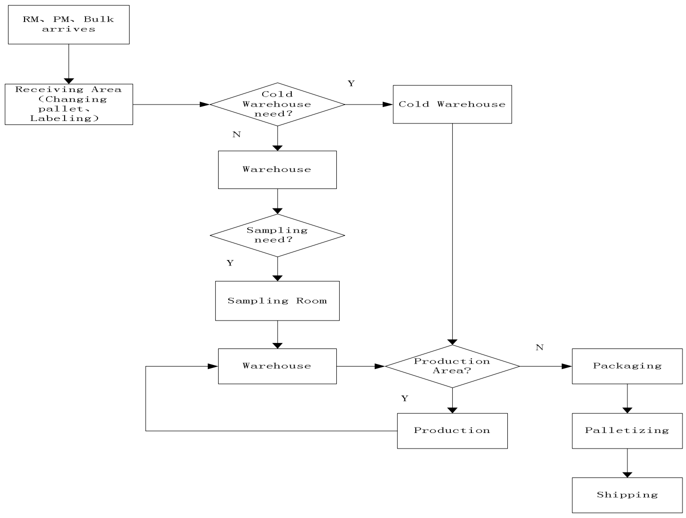

Figure 1.The operation workflow

2 LOGISTIC CONDICTION ANALYSIS

In the logistics center, the logistic structure and quantity every day is shown in figure 2.

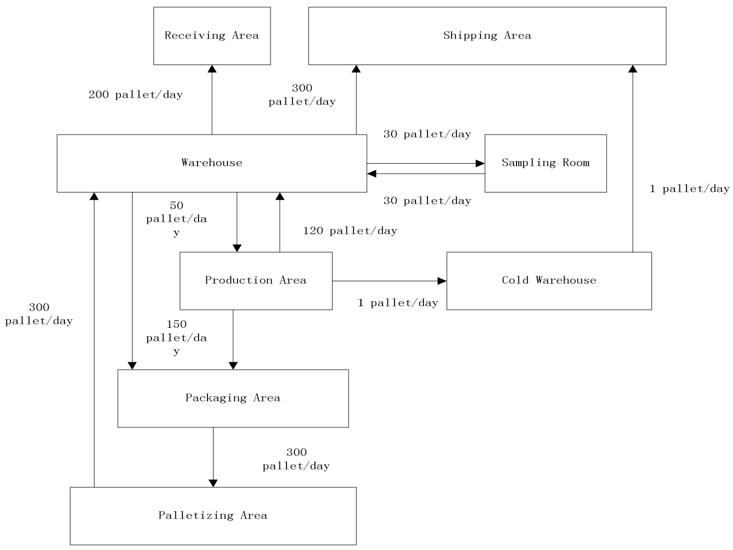

Figure 2. The logistic structure and quantity

3 Logistics relationship analysis

There are eight kinds of area in the system, including receiving and shipping area, common warehouse, cold warehouse, sampling room, production area, packaging area and palletizing area, which represented by 1-7 respectively. On the basis of workflow analysis and the logistics data, the logistics intensity is calculated in table 2.

Table 2.The logistics intensity

Number	Area 1	Area 2	Throughput（pallet/day）	Throughput Proportion（%）	Grade
1	1	2	500	33.7	A
2	6	7	300	20.2	E
3	2	7	300	20.2	I
4	2	5	170	11.5	O
5	2	6	150	10.1	U
6	2	4	60	4.1	U
7	1	3	1	0.1	U
8	3	5	1	0.1	U

4. Non-logistics relationship analysis

In the pharmaceutical enterprise, some special pharmaceutical rules must be paid much attention, as follows:
(1)The requirement for clean extent of different functional areas is different;
(2)The forklift and operator can be shared between different areas;
(3)There is no flammable risk between the two areas.

The non-logistics intensity is shown in table 3. It's worth noting that the production area and sampling room are in concentrated areas of chemical drug and it's better to set aside the aisle and window area, in order to keep the area of ventilation.

Table 3.The non-logistics intensity

Number	Area 1	Area 2	Reason	Grade
1	1	4	（1）、（3）	X
2	1	5	（1）、（3）	X
3	2	4	（1）、（3）	X
4	2	5	（1）、（3）	X
5	3	4	（1）	X
6	3	5	（1）	X
7	4	5	（1）	E
8	5	6	（2）	E

The weight of logistics factor and non-logistics factor is set in the ratio of 2:1, the table of comprehensive relationship is shown in table 4.

Table 4.The comprehensive relationship

			Affinity Degree on different Areas					
Number	Area 1	Area 2	Logistics Factor（Weight：2）		Non-logistics Factor（Weight：1）		Comprehensive Relationship	
			Grade	Mark	Grade	Mark	Mark	Grade
1	1	2	A	4			8	A
2	6	7	E	3			6	E
3	2	7	I	2			4	I
4	4	5			E	3	3	O
5	5	6			E	3	3	O
6	2	5	O	1	X	-1	1	U
7	1	3	U	0			0	U
8	2	6	U	0			0	U
9	2	4	U	0	X	-1	-1	X
10	3	5	U	0	X	-1	-1	X
11	3	4			X	-1	-1	X
12	1	4			X	-1	-1	X
13	1	5			X	-1	-1	X

RESULTS AND DISCUSSION

PLANE DESIGN

Considering the comprehensive relationship among functional areas, the 1F Layout and the 2F Layout are shown in figure 3. The 1F layout includes receiving and shipping area, warehouse, cold warehouse, production area, packaging area and sampling room. For convenience, warehouse and palletizing area are placed on 2F.

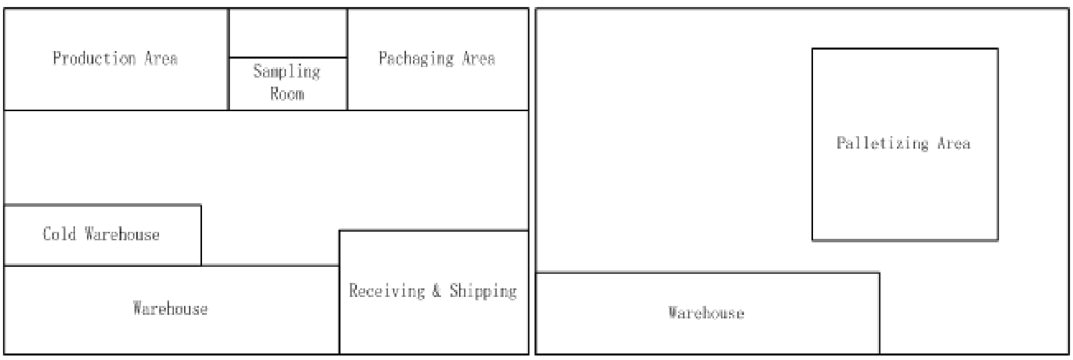

Figure 3.The 1F & 2F Layout

DYNAMIC SIMULATION

By using the Flexsim simulation software, the layout designed above could be displayed through 3D dynamic perspective drawing, as shown in figure 4. The logistics costs and functional areas efficiency could also be obtained through simulation data analysis.

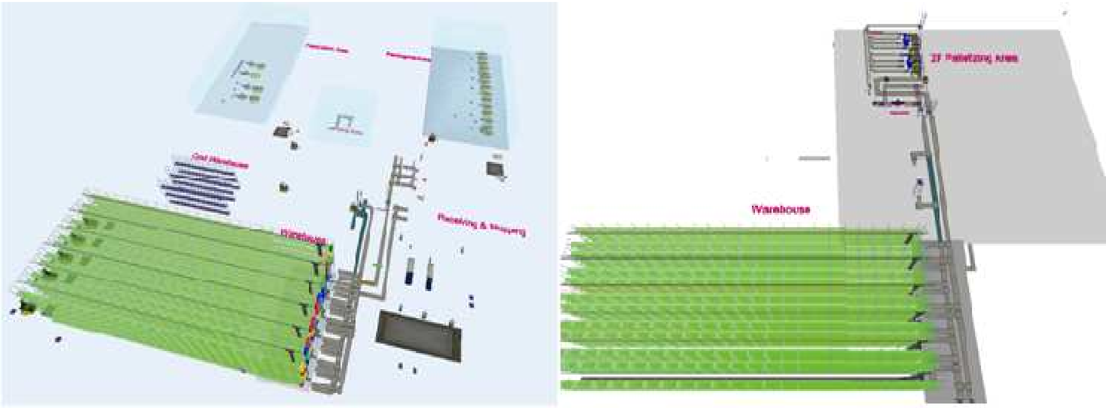

Figure 4.The model of 1F & 2F Layout

The statistical result is derived from simulation model running 86400 seconds (24hours), as shown in table 5. The key entity state is listed in the table, including:
(1) 6 stackers in the warehouse handling 1200pallet/day approximately;
(2) 8 trucks arrived and receiving 200pallet/day totally;
(3)13 shipping trucks, a total of 305pallet/day;
(4)300pallet/day processed by sampling room.

In addition, because of the upper limit of receiving and shipping content is 80pallet, the real-time condition of this area needs to be paid more attention. By figure 7 we can see that this area capacity can well meet the requirement.

Table 5.The state report table

Flexsim Summary Report						
Time: 86400						
Object	Content Max	Input	Output	Min Staytime	Max Staytime	Avg Staytime
ASRSvehicle_subway1	1	202	202	16.243494	32.25222	23.305
ASRSvehicle_subway2	1	198	198	16.236004	33.31562	23.53
ASRSvehicle_subway3	1	197	197	16.201269	32.34959	23.334
ASRSvehicle_subway4	1	195	195	16.261156	32.34408	23.396
ASRSvehicle_subway5	1	193	193	16.193544	32.24847	23.369
ASRSvehicle_subway6	1	190	190	16.260389	32.2843	23.284
Queue_carbuffer149	1	21	21	0	0	0
Queue_car151	1	4	4	2372.248779	5073.441	3947.9
Queue_car156	1	4	4	800.297668	4692.25	3719.3
Conveyor_sample1out	1	30	30	79.464287	1082.622	170.88
Queue54	6	300	300	34.953434	807.9227	115.16
C_rack87	5	5	5	2790.882568	3475.253	3042

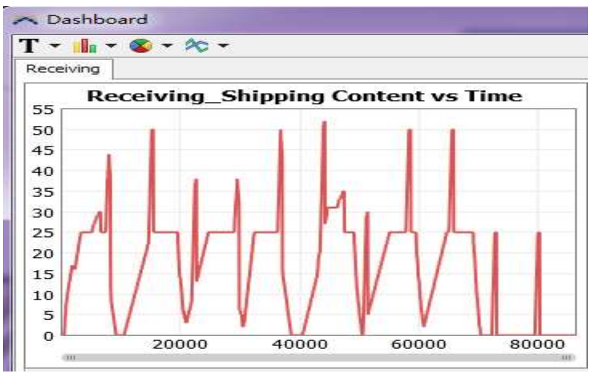

Figure5.The receiving & shipping area report data

CONCLUSION

In this paper, the integration logistics center of chemical and pharmaceutical enterprises is taken into consideration. Combined with dynamic simulation technology, the multi-function area design and planning are realized. First, by the quantitative analysis of the logistics and non-logistics relationship, the comprehensive relationship between functional areas is obtained. On this basis, the static layout is proposed and the dynamic simulation is realized on the platform of Flexsim. Finally, by simulated running, the statistical performance data can be gathered and the effect of design scheme can be verified.

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