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Assessment of the Feasibility of Production of Dry Pack Modified Mortar Using the Method of Additive Convolution

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Abstract

This article discusses the use of the method of additive convolution in assessing the behavior of the enterprise strategy. It is shown that the additive convolution presented information suggests better alternative strategy modification of an existing product.

Keywords: dry pack mortar, calcium Hydrosilicates, alternative of production management, method of additive convolution

Introduction

The analysis of the market of decorative plaster dry pack mortar says that today in the domestic construction market is observed the increase in production of the domestic decorative dry pack mortar, which quality aren't conceding to foreign analogs. At the same time, most of the decorative dry mixtures of Russian production in its composition contain chemical and polymer additives of imported production, making production dependent on foreign supplies. In connection with this urgent problem of development of modern types and range of dry pack mortar using domestic modifying additives.

For the production of dry calcareous offer energy saving technology of synthesis of fine fillers based on calcium Hydrosilicates, contained in their synthesis of liquid sodium glass with additive - precipitant, the amount of the precipitant in 30-50% of the weight of the liquid glass in the form of 7,5-15% solution and subsequent drying at a temperature of 105 °C [1,2].

Structure was designed for exterior and interior walls of buildings in the form of a dry mixture including hydrated lime, filler based on calcium Hydrosilicates, sand, plasticizer-3 and redispersible powder Neolith P7200, this structure allows to obtain mortars with water-holding capacity of 98-99 %, drying time to a degree of 5 for 15-20 min, the viability of 1-1,5 hours. Coatings based on the proposed dry construction mixtures are characterized by water vapor permeability coefficient of 0,05 - 0,07 mg / m · h · Pa adhesive strength of 0,6-0,9 MPa, compressive strength of 3-4 MPa. Flow dry mixture is 1,0 - 1,2 kg / m^2 [3].

The issue of the expediency of manufacturing of dry mixes at the enterprise with the addition based of calcium Hydrosilicates was resolved by using the method of additive convolution [4]. In this regard, the following strategies (alternatives) enterprise behavior were possible:

Strategy a_1 — reduction of price of the available production.

Strategy a_2 - modification of an existing product introduction in compounding admixture based Hydrosilicates calcium. The strategy will require additional costs on production additives, readjustment of production of dry pack mortar due to the introduction of additional equipment (feeders, hoppers, etc.), but it will provide some improvement in product quality. The implementation of such a strategy can attract new customers by promoting a new redistribution of market shares between the companies. Competition in this case is not so strong and so price.

Strategy a_3 - development of new compounding of dry pack mortar. This strategy will require additional and substantial costs, but it will help in case of success be ahead of the competition in technology development and to be a monopolist in the market for a while.

Strategy a_4 - the search for new markets for existing products. In this case the company can increase sales by finding new markets and joining them, but it does not entail a redistribution of the old market. This strategy is also quite likely to result in strong competition and increasing spending on marketing research and new production capacity.

For assessment of alternatives was identified the following criteria:

c_1 - the costs of expansion of production; c_2 - the project implementation; c_3 – the cost of marketing research; c_4 - administrative expenses; c_5 - the risk of loss; c_6 - payback period; c_7 - quality products; c_8 - the price of products.

For an assessment of relative importance of criteria the expert preferences presented by means of the indistinct numbers having functions of accessory of a triangular look were used. The following scale of values was considered: *1-almost* *unimportant; 2-not really important; 3-quite important; 4 - the important; 5 - the very important*. Values of terms of this set are presented in fig. 1.

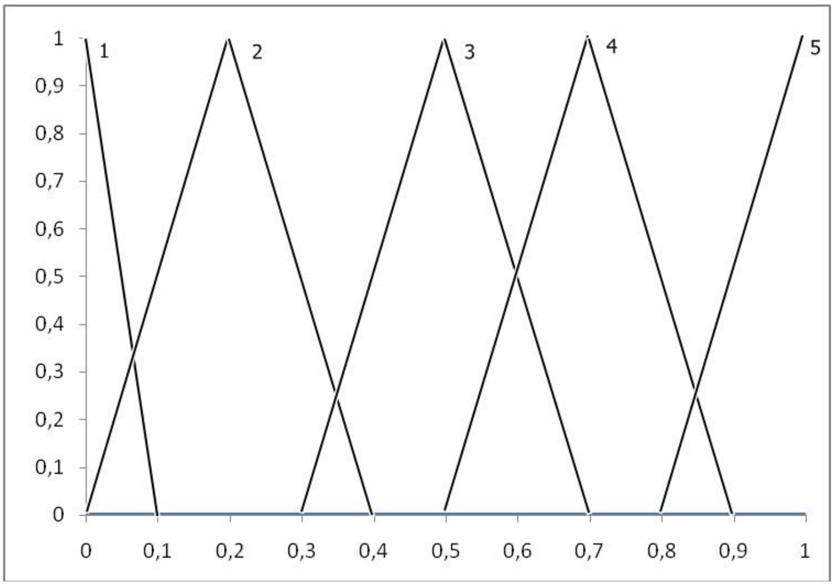

Fig.1 Function of affiliation of the terms of the importance of criteria

According to experts the following criteria correspond to the linguistic assessment of the relative importance α_{c_1} = "fairly important", α_{c_2} = "important", α_{c_3} = "important", α_{c_4} = "almost unimportant", α_{c_5} = "fairly important", α_{c_6} = "fairly important", α_{c_7} = "very important", α_{c_8} = "quite important".

The degree of satisfaction of the expert on the proposed criteria with the possible implementation of each of the alternatives characterized linguistic variable *S*. Choose the following values of the variable *S: 1- low, 2 - medium, 3 - high, 4 - very high*.

Membership function of the terms of the variable *S* are shown in Fig. 2.

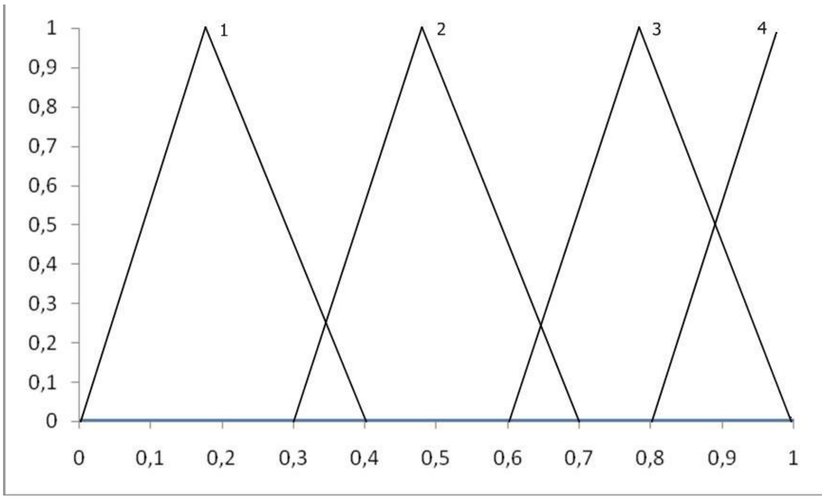

Fig. 2. Membership functions by value of the degree of satisfaction of experts on the proposed criteria

Assessment of Alternatives variable S is shown in Table 1.

Table 1
Assessment of alternatives on the degree of satisfaction of criteria

Criteria	Alternative			
	a_1	a_2	a_3	a_4
c_1	High	Medium	Low	Medium
c_2	Medium	High	High	Medium
c_3	Very high	Medium	Medium	Low
c_4	High	Very high	Very high	Very high
c_5	Medium	High	Medium	Medium
c_6	High	Very high	High	Medium
c_7	Medium	Very high	High	High
c_8	Low	High	Medium	High

The Results of Studies

Additive convolution of the provided information was carried out. In this method of processing fuzzy information low scores have the same status as compared to the high that is most suitable for the calculation of risks to innovate. If there are many alternative $a_i,\ i=\overline{1,4}$ and many criteria $c_j,\ j=\overline{1,8}$, the assessment *j*-alternative to the *i*-criteria is represented fuzzy number and the relative importance of the *i*-criteria is defined fuzzy coefficient $\alpha_i,\ i=\overline{1,\,4}$. Weighted assessment *j*-alternative in this case is calculated by the formula

$$R_j=\sum_{i=1}^{4}\alpha_i R_{ij}$$

Weighted assessment the *j*- alternative is the result of a linear combination of fuzzy numbers. It will also have a membership function of a triangular appearance. Membership function has two boundaries: bottom *a* and a top *b*. Continuous normal convex fuzzy number *A* analytically can be written as

$$A=\int_a^A (x-a)/x+\int_A^b (b-x)/x$$

So, for example, analytically the fuzzy number is represented as follows:

$$\alpha_1=\int_{0,3}^{\alpha_1}(x-0{,}3)/x+\int_{\alpha_1}^{0,7}(0{,}7-x)/x$$

Let the *x* – is a double operation of fuzzy numbers *A* and *B*. Then

$$A\times B=\left(\int_a^A (x-a)/x+\int_A^b (b-x)/x\right)\times\left(\int_{a'}^B (x-a'')/x+\int_B^{b'} (b'-x)/x\right)=$$
$$=\int_{a''}^{A\times B}\mu_{A\times B}/x+\int_{A\times B}^{b''}\mu_{A\times B}/x,$$

here a'' and b'' receive from a, b, a', b' depending on the particular operation. The function $\mu_{A\times B}$ is determined depending on the specific operation and normalization. In the calculation R_j using the operations of addition and multiplication of fuzzy numbers:

$$C=A+B=\int_{a''}^{C}\frac{x-a''}{C-a''}/x+\int_{C}^{b''}\frac{b''-x}{b''-C}/x\text{, where }a''=a+a',\ b''=b+b'$$

$$C=A\cdot B=\int_{a''}^{C}\frac{\sqrt{x}-\sqrt{a''}}{\sqrt{C}-\sqrt{a''}}/x+\int_{C}^{b''}\frac{\sqrt{b''}-\sqrt{x}}{\sqrt{b''}-\sqrt{C}}/x\text{, where}$$
$$a''=a\cdot a',\ b''=b\cdot b'.$$

To determine the weighted assessment alternatives a_1 workflow in the formula:

$$R_1 = \alpha_1 \cdot R_{11} + \alpha_2 \cdot R_{21} + \alpha_3 \cdot R_{31} + \ldots + \alpha_8 \cdot R_{81}$$

For example, to obtain a fuzzy number multiplies numbers α_1 and R_{11},

$$R_{11} = \int_{0,6}^{R_{11}} (x - 0{,}6)/x + \int_{R_{11}}^{1} (1 - x)/x .$$

Then $\alpha_1 \cdot R_{11} = \int_{0,18}^{0,4} \frac{\sqrt{x} - \sqrt{0{,}18}}{\sqrt{0{,}4} - \sqrt{0{,}18}} / x + \int_{0,4}^{0,7} \frac{\sqrt{0{,}7} - \sqrt{x}}{\sqrt{0{,}7} - \sqrt{0{,}4}} / x$

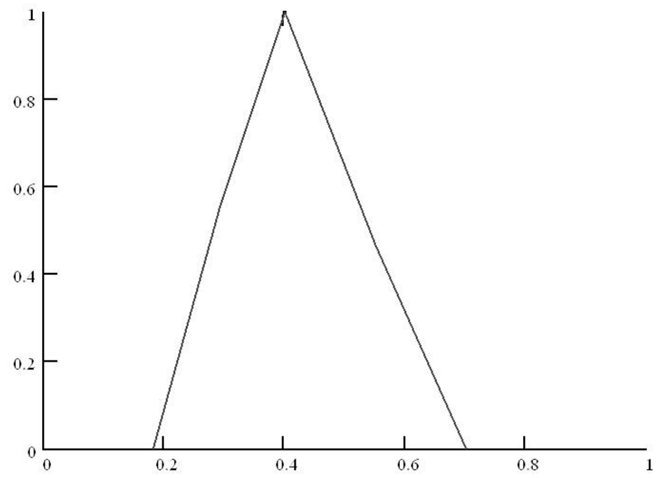

Fig. 3 Fuzzy number $\alpha_1 \cdot R_{11}$

Similarly, extending the calculation of convolution, we obtain the graphical representation of weighted assessment of alternatives. The results are shown in fig. 4.

The priority of each alternative is computed by selecting the minimum among the points of intersection of the right border of its corresponding fuzzy number R_j with the boundaries of fuzzy numbers representing the weighted evaluation of alternatives, located right on the number line. It is assumed that the right boundary of the domain of definition of fuzzy numbers corresponding to the preferred estimates, and the left - the worst.

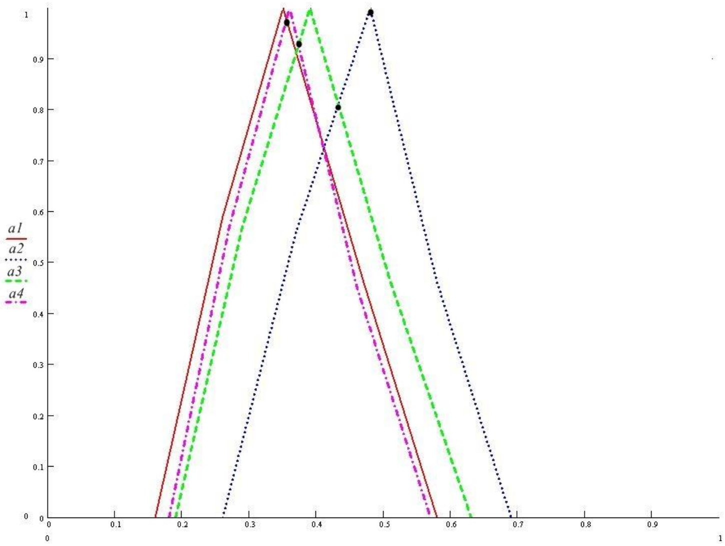

Fig. 4 Graphical representation of weighted assessment the considered alternatives R_1, R_2, R_3, R_4

Conclusions

Additive convolution of the submitted information results:

$$\mu(j) = \{0{,}98/a_1;\ 1{,}0/a_2;\ 0{,}78/a_3;\ 0{,}92/a_4\},$$

what allows to consider a better alternative a_2. This allows us to consider appropriate modifications to existing product strategy by introducing a formulation admixture based on calcium Hydrosilicates.

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