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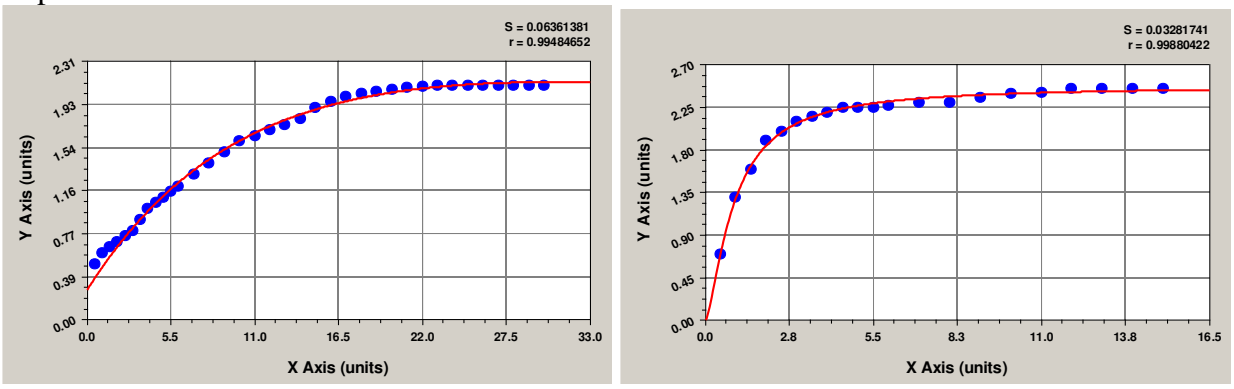
THE USE OF A SINGLE-PARAMETRIC REGEPTIONAL ANALYSIS FOR CHROME(VI)-SELECTIVE ELECTRODE MANUFACTURE PARAMETERS OF MODELING AND OPTIMIZATION

The use of ion-selective electrodes (ISE) in the flow-injection method extends the range of application of potentiometric methods of analysis in technological processes and systems of automatic control of the chemical, light, processing and food industries. To provide information and measurement systems for water quality control, various solid-state ISEs with an increased selectivity coefficient have been developed [1-2]. Solid-state electrodes can be made from various materials and in different ways [Patent UA 3914]. By selecting a suitable material, almost any membrane electrode reversibly functioning with respect to any type of ion can be created. The greatest phytotoxicity in chromium compounds is hexavalent chromium, since it is an anion of chromic acid and is practically not fixed by soil colloids bearing predominantly a negative charge. To ensure information environmental safety in industry, we made a chrome(VI)-selective electrode using the method of anodic polarization of electrode-active substance $PbCrO_4$. A powder of finely dispersed metallic lead with a binder polymer was chosen as the basis of the ISE.

Figure 1 shows the dependences in the coordinates of the values of pCr(VI) corresponding to the potential values in mV.



a) b)

Fig.1 – Dependences in the coordinates of the values of pCr(VI) corresponding to the potential values in mV: a) for 10 μA, b) for 20 μA

Tables 1 and 2 show the mathematical models of the anodic polarization of the electrode-active substance PbCrO4 ranked by the correlation coefficient using single-parameter regression analysis.

The calculation of the anode polarization time at 10 mA is 1340 seconds; at 20 mA, it is 289 seconds. The thickness of the electrode-active substance $PbCrO_4$ in the first case was 10^{-4} cm, in the second case $1.34 \cdot 10^{-4}$ cm at an anode polarization voltage of 1.8 V. The electrode area was 0.038 cm^2. The resistance of the electrode is 13 MΩ. In the second case, with a decrease in time

by a factor of 4, the polarization of the electrode-active material occurs rapidly with the subsequent detachment of the electrode itself.

Table 1 – Regression models for current density of 10 μA/mm^2, which are ranked by the correlation coefficient. No weighting used.

Rank	Model family	Model equation	Coefficient Data	Correlation Coefficient	Standard Error
1	Rational Function	$y = \frac{a+bx}{1+cx+dx^2}$	a =0.26857202 b =0.22933477 c =0.050633086 d =0.00093894765	0.9948465	0.0636138
2	Exponential Association (3)	$y = a(b-e^{-cx})$	a =1.9585329 b =1.1293853 c =0.11641167	0.9945055	0.0647061
3	3rd degree Polynomial Fit	$y = a+bx+cx^2+dx^3+...$	a =0.30991959 b =0.18580957 c =-0.0064485798 d =7.5131655·10^{-5}	0.9945676	0.0653078
4	MMF Model	$y = \frac{ab+cx^d}{b+x^d}$	a =0.16720273 b =8.0240498 c =2.8598083 d =0.94709159	0.9932694	0.0726703
5	Quadratic Fit	$y = a+bx+cx^2$	a =0.38975884 b =0.14785349 c =-0.0031264694	0.9921311	0.0773892
6	Sinusoidal Fit	$y = a+b\cos(cx+d)$	a =-7.832466 b =9.9727684 c =0.025458059 d =-0.59982119	0.9916832	0.0807486
7	Logistic Model	$y = \frac{a}{(1+be^{-cx})}$	a =2.0972944 b =3.5106934 c =0.24668648	0.9893474	0.0899801
8	Exponential Association	$y = a(1-e^{-bx})$	a =2.1311064 b =0.14961834	0.9861538	0.1010279

Table 2 – Regression models for current density of 20 μA/mm^2, which are ranked by the correlation coefficient. No weighting used

Rank	Model family	Model equation	Coefficient Data	Correlation Coefficient	Standard Error
1	MMF Model	$y = \frac{ab+cx^d}{b+x^d}$	a =-0.0047262335 b =0.90884834 c =2.4712713 d =1.4316027	0.9988042	0.0328174
2	Exponential Association	$y = a(1-e^{-bx})$	a =2.3698987 b =0.74071509	0.9959037	0.0575814
3	Exponential Association (3)	$y = a(b-e^{-cx})$	a =2.3604005 b =1.0042649 c =0.73700304	0.9959113	0.0590221
4	Rational Function	$y = \frac{a+bx}{1+cx+dx^2}$	a =-0.050576924 b =2.5299951 c =0.87988542 d =0.0066658163	0.9959108	0.0606430
5	Logistic Model	$y = \frac{a}{(1+be^{-cx})}$	a =2.3184362 b =6.0420565 c =1.7083576	0.9802390	0.1292458

Thus, mathematical models of anodic polarization of electrode-active substance $PbCrO_4$ for creating Cr(VI)-selective electrode on the basis of one-parameter regression analysis were obtained. The parameters of obtaining an ion-selective electrode with the Cr(VI)-function are

optimized on the basis of a rational choice of the current density, voltage and the time of its manufacture.

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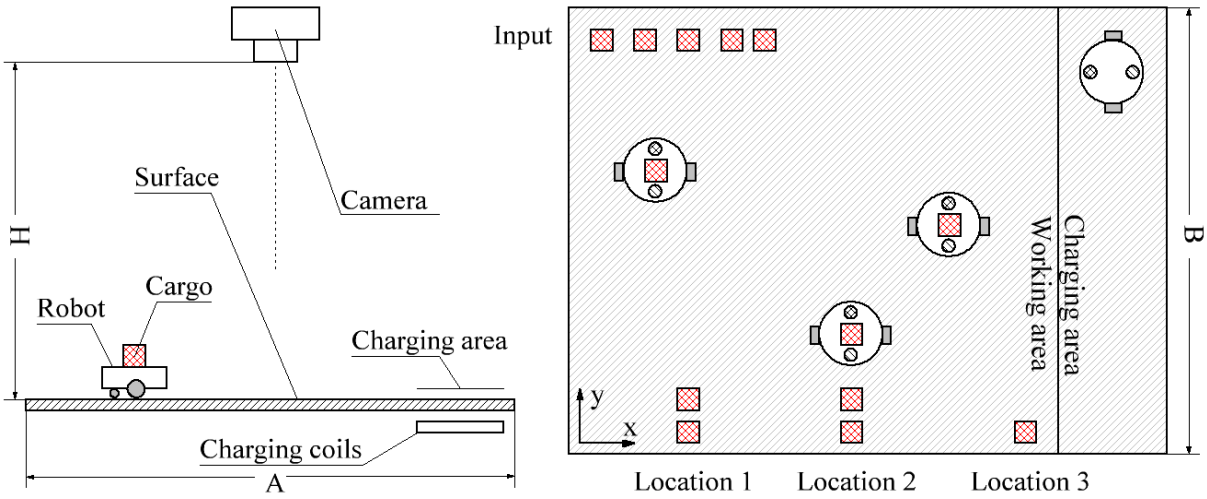
DISTRIBUTED AUTONOMOUS DELIVERY SYSTEM BASED ON MOBILE ROBOTS WITH WIRELESS CHARGING

Nowadays with increasing amount of parcels around the world big courier deliver services meet problems with sorting systems. Conveyor is well known and commonly used solution in this case. It is simple to implement and use. But main disadvantage of such approach is the fact that system has fixed amount of inputs and outputs. Every day load on separate parts of conveyor system is not fixed. While production of conveyor system it is quite complex to determine design that would be able flexibly adapt to variable load.

At this moment many companies give preference to systems based on mobile robots. So called line following robots (where robot follows colored lines on the floor) are commonly used due to the simplicity of construction. The next step was made by using cameras to track position of each robot. This gives ability to make the system that can dynamically change its structure and adapt to current needs. Companies like Amazon have made a big step in this area and showed advantages of such approach [1].

This paper presents delivery system based on two wheeled mobile robots. The detailed diagram of this system is shown in the fig.1.(a) and fig.1.(b).



a) b)

Fig. 1 – Appearance of delivery system front view a) top view b)