



TECHNOLOGY FOR PRODUCING NPK-BASED LIQUID CHELATE FERTILIZERS CONTAINING MICROELEMENTS

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Abstract: This in the article Based on FeCl_3 and EDTA-Na_4 ($\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}_8\text{Na}_4$). liquid chelate fertilizers to take technology working exit according to take visited research results The concentration of FeCl_3 (10-60%) and the norm of EDTA-Na_4 (50-150%) change the pH, temperature, density, viscosity and electricity conductivity such as physicochemical to the features impact studied by SEM-EDS method. elemental analysis performed fertilizer in the composition macroelements (C, O, Na) and the presence of microelements (Fe, Cl) The study found that results chelate fertilizer optimal conditions for obtaining designation opportunity gave : FeCl_3 concentration 10-50%, EDTA-Na_4 norm 100-150%, pH value in the range of 3.0-7.8 when stable solution harvest to be determined.

Key words: liquid chelate fertilizers, EDTA-Na_4 , FeCl_3 , physicochemical properties, SEM-EDS, pH, viscosity.

Аннотация: В данной статье на основе FeCl_3 и EDTA-Na_4 ($\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}_8\text{Na}_4$) рассматривается технология получения жидких хелатных удобрений, разработанная на основе результатов проведенных исследований. Концентрация FeCl_3 (10-60%) и концентрация EDTA-Na_4 (50-150%) изменяют такие физико-химические характеристики, как pH, температура, плотность, вязкость и электропроводность, что было изучено методом SEM-EDS. Элементный анализ удобрения проводился для определения его состава макроэлементов (C, O, Na) и наличия микроэлементов (Fe, Cl). Исследование показало, что оптимальные условия получения хелатного удобрения следующие: концентрация FeCl_3 10-50%, концентрация EDTA-Na_4

100-150%, значение pH в диапазоне 3,0-7,8, при котором достигается стабильный урожай.

Ключевые слова: жидкие хелатные удобрения, ЭДТА- Na_4 , FeCl_3 , физико-химические свойства, СЭМ-ЭДС, pH, вязкость.

INTRODUCTION

Modern village on the farm of plants to microelements was need in satisfaction chelated fertilizers separately importance has. Chelate compounds micronutrient elements plants by easy adaptable in the form storage opportunity Iron chelates in plants chlorosis treatment and prevent in receiving wide EDTA (ethylenediaminetetraacetic acid) is used acid (based)chelates the most wide widespread and stable from complexes one is considered.

Liquid chelate fertilizers working in the release solution physicochemical properties - pH, density, viscosity and electricity conductivity important parameters are, they are of fertilizer preservation deadline, application technology and biological to the efficiency directly impact shows. This of the research purpose in the $\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}_8\text{Na}_4$ (EDTA- Na_4) - FeCl_3 - H_2O system solution physicochemical features reagents concentration and to the ratio dependence study and optimal composition from determining consists of.

MATERIALS AND RESEARCH METHODS

In the study, ferric chloride (FeCl_3) and ethylenediaminetetraacetic acid tetrasodium of acid salt (EDTA- Na_4 , $\text{C}_{10}\text{H}_{12}\text{N}_2\text{O}_8\text{Na}_4$) was used. of FeCl_3 in the water 20% EDTA- Na_4 solution as per standard added. Experiment on 18 samples The concentration of FeCl_3 was from 10% to 60%, the EDTA- Na_4 rate was at 50%, 100% and 150%. was changed (Table 1).

Prepared pH value, temperature, electricity in solutions permeability, density and cinematic viscosity (mm^2/s) was measured. Measurements were made at a temperature of 29-30°C. between take went. Harvest was solutions stability visual observation through was evaluated (precipitation existence).

Liquid chelate fertilizer elemental composition of the sample determination for scanner electronic microscopy and energy-dispersive X-ray spectroscopy (SEM-EDS) method Analysis Spc_009 ZAF quantification in Standardless mode method with was held.

RESULTS AND DISCUSSION

Table 1. The composition of the FeCl₃- EDTA-Na₄ - H₂O system physicochemical features

№	FeCl ₃ concentration, %	EDTA-Na ₄ norm, %	Amount of added EDTA-Na ₄ , ml	pH	T, °C	Electricity conductivity, µS/cm	Density, kg/m ³	Viscosity, mm ² /s
1	10	50	58.50	1,608	30.3	324.7	1085	1.0566
2	20	50	116.99	1,450	30.6	334.6	1128	1.2488
3	30	50	175.49	1,361	30.6	339.9	1160	1.4089
4	40	50	233.98	1,577	30.5	326.8	1137	1.4729
5	45	50	263.23	1,295	30.6	343.8	1175	1.5690
6	50	50	292.48	1,271	30.4	345.3	1184	1.6330
7	10	100	116.99	2,938	29.9	244.1	1073	0.8966
8	20	100	233.98	3,443	29.6	213.9	1081	0.9286
9	30	100	350.97	3,623	29.7	202.9	1087	0.9606
10	40	100	467.96	6,517	29.1	209.1	1105	0.9926
11	45	100	526.46	4,201	30.5	168.8	1091	1.0246
12	50	100	584.95	3,653	30.6	201.9	1102	1.0887
13	10	150	175.49	6,532	30.6	28.1	1094	1.0246

№	FeCl ₃ concentration, %	EDTA-Na ₄ norm, %	Amount of added EDTA-Na ₄ , ml	pH	T, °C	Electricity conductivity, µS/cm	Density, kg/m ³	Viscosity, mm ² /s
14	20	150	350.97	6,521	30.6	29.0	1116	1.0887
15	30	150	526.46	6,468	30.7	32.2	1122	1.1207
16	40	150	701.94	7,795	30.6	48.1	1124	1.1847
17	50	150	789.68	6,486	30.5	31.1	1133	1.2488
18	60	150	877.43	6,426	30.3	34.7	1135	1.2808

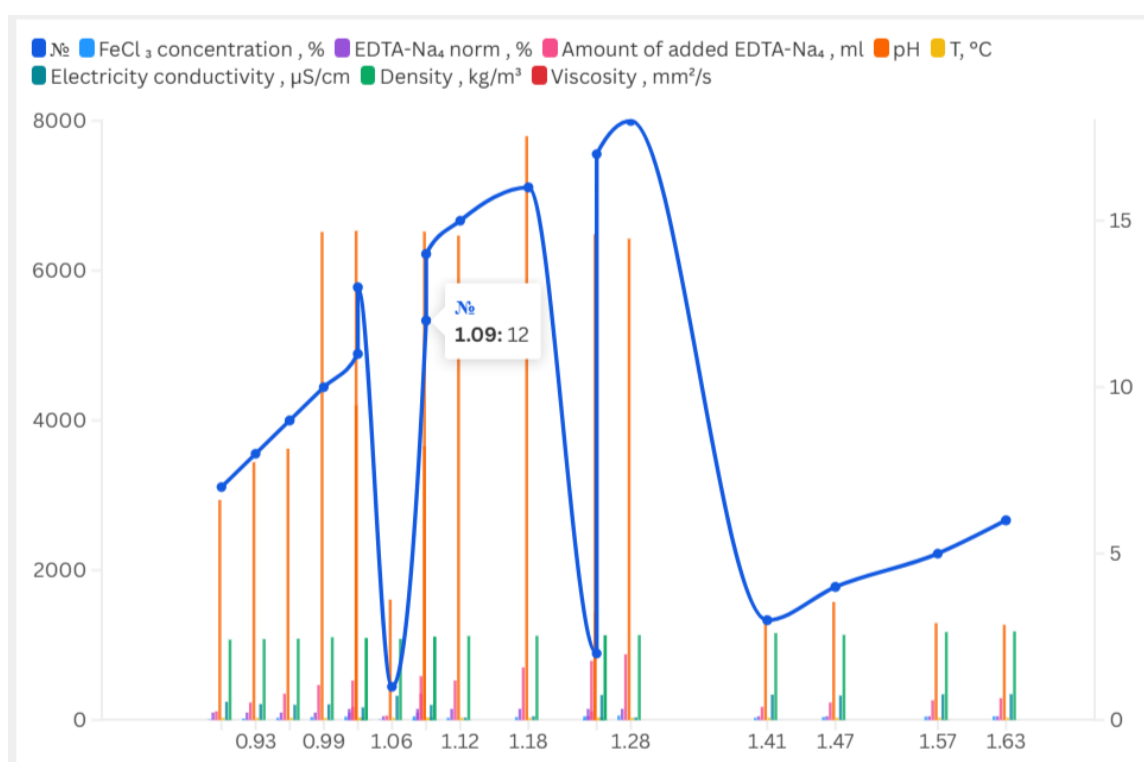


Figure 1 Viscosity properties of the FeCl₃ - EDTA-Na₄ - H₂O system

pH value change. Research results this showed that the amount of EDTA-Na₄ increase with pH value of the solution. When the EDTA-Na₄ norm is 50%, the pH is between 1.27-1.61. If, at 100% normal pH is 2.94-6.52, at 150% normal and pH 6.43-7.80 increases. In sample 16, with a FeCl₃ concentration of 40% and an EDTA-

Na₄ norm of 150%, the pH reached 7.795. At high pH values (6.5-7.8), iron chelate of the complex stability provision for comfortable conditions creates, because chelate complexes in the pH range of 4.0-7.0 the most stable is considered.

Electricity conductivity. Highest electricity conductivity (343.8-345.3 $\mu\text{S/cm}$) EDTA-Na₄ norm 50% and FeCl₃ concentration is 45-50% in samples record When the amount of EDTA-Na₄ is increased to 100% electricity conductivity up to 168.8-244.1 $\mu\text{S/cm}$ decreased. 150% of the norm and electricity conductivity sharp decreased to 28.1-48.1 $\mu\text{S/cm}$ organization This is EDTA - Na₄ free ions number reducing, complexes harvest to be with explained.

Density. Solution density FeCl₃ concentration increase with increases. The lowest density (1073 kg/m³) in 10% FeCl₃ and 100% EDTA-Na₄ norm (sample 7), the most high Density (1184 kg/m³) recorded at 50% FeCl₃ and 50% standard (sample 6) When the EDTA-Na₄ norm is 150% Density in the range of 1094-1135 kg/m³ is relatively stable indicator manifestation did.

Viscosity. Kinematic viscosity FeCl₃ concentration increase with all in series increasing goes. 50% is normal viscosity from 1.0566 to 1.6330 mm²/s, at 100% of the norm from 0.8966 to 1.0887 mm²/s, at 150% of the norm and from 1.0246 to 1.2808 mm²/s changed. Highest viscosity 50% FeCl₃ and 50% EDTA-Na₄ norm observed in sample 6 (1.6330 mm²/s).

Precipitation harvest to be Visual observations As a result, the EDTA-Na₄ norm was 50%. all samples (sample 6) and sample 12 at 100% standard, as well as samples 17 and 18 at 150% standard, sediment harvest that was detected. Precipitation harvest to be solution chelate capacity fullness and excess iron ions hydrolysis as a result to the surface is coming.

SEM-EDS analysis results. Prepared liquid chelate fertilizer dry in the remainder elemental analysis performed following the results showed (Table 2).

Table 2

SEM-EDS method extracted element composition (Spc_009)

Element	Line	Mass %	Atomic %
C	K	42.52 ± 0.08	54.79 ± 0.10
Oh	K	38.49 ± 0.12	37.23 ± 0.12
No	K	6.68 ± 0.04	4.50 ± 0.02
Hand	K	0.19 ± 0.01	0.11 ± 0.00
Cl	K	1.78 ± 0.01	0.78 ± 0.01
Fe	K	8.95 ± 0.05	2.48 ± 0.01
Pt	M	1.38 ± 0.02	0.11 ± 0.00
Total		100.00	100.00

Spc_009 fitting ratio: 0.0154, Non-standardized ZAF method

SEM-EDS analysis fertilizer in the composition carbon (42.52% by mass) and oxygen (38.49% mass) elements high in quantity that This shows that EDTA- Na₄ organic structure and carboxyl groups existence with Sodium (6.68% mass) is present in EDTA -Na₄ arrived is, its amount chelating agent agent's elementary to the amount depends.

8.95% by mass of iron in the amount of (2.48 atomic %) of the fertilizer main microelement with iron as enriched Chelated iron plants by easy will be mastered and to chlorosis against effective tool is considered.

Chlorine (1.78% mass) in FeCl₃ chloride ion residue as The rest is aluminum (0.19%) and platinum (1.38%). to be determined, perhaps, sample preparation or tool materials with related to be possible. In SEM-EDS analysis, platinum is often metallization in the process is used.

Received results this shows that the optimal composition is a concentration of 10-40% FeCl_3 and in 100-150% EDTA- Na_4 norm harvest will be. Under these circumstances solution pH= 6.5-7.8 to be, chelate of the complex stability is provided. At a concentration of 50% FeCl_3 and all normative in sizes sediment observed, this of iron chelate from capacity increasing that he/she has left shows.

Research results chelate fertilizers working in the release reagents concentration and ratio right choice importance shows. Too much outside high iron concentration solution stability reduces and sediment harvest to be take comes. With this together, the amount of EDTA- Na_4 increase in pH value increases, this and iron hydroxide harvest of being prevent takes.

CONCLUSION

Transferred research as a result following to conclusions bride :

1. In the system FeCl_3 - EDTA- Na_4 - H_2O , the pH value of the amount of EDTA- Na_4 increase with increases (from 1.27 to 7.80). This chelate complex harvest to be process important indicator is considered.
2. Electricity conductivity EDTA- Na_4 norm is the highest at 50% high (345.3 $\mu\text{S}/\text{cm}$), and at 150% sharp decreases (28.1 $\mu\text{S}/\text{cm}$), which free ions number decrease with explained.
3. Density and viscosity FeCl_3 concentration increase with increasing goes. The highest The viscosity (1.6330 mm^2/s) was observed in 50% FeCl_3 and 50% EDTA- Na_4 solutions.
4. SEM-EDS analysis fertilizer contains C (42.52%), O (38.49%), Na (6.68%) and Fe (8.95%) confirmed that chelate fertilizer quality the composition proves.
5. Chelate fertilizer Optimal conditions for extraction : FeCl_3 concentration 10-40%, EDTA- Na_4 norm 100-150%, pH 6.5-7.8, in which stable solution harvest will be. Above 50% At a concentration of FeCl_3 sediment observed.

Offer being done technology based on taken liquid chelate fertilizer village farm crops leaf through and root from below in feeding application recommendation will be done. In the future taken of fertilizer various soil-climate under the circumstances agronomic efficiency study to the goal is appropriate.

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