The disinfecting properties of Penox-1 solutions for sanitation of objects of veterinary supervision

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Abstract. In the literature there is no complete data on the use of slaked lime as a disinfectant disinfectant. All veterinary publications indicate that a 10 - 20% solution of slaked lime has a disinfecting effect. However, the technology of carrying out, as well as modes of disinfection, are not specifically indicated in any literature. There is no data on which infectious diseases they affect, at what concentration, exposure and consumption of the disinfectant it can be applied, on smooth or rough surfaces, the frequency of whitewashing or wet disinfection, etc. Until now, the issue of the solubility of slaked lime in water and other chemical compounds has not been completely resolved. In addition, the lack of a disinfectant - 10 - 20% slaked lime, is a low disinfection efficiency, high corrosion activity in relation to metal products, a large flow rate of a solution of 1 -1.5 l / m², which is carried out 2 - 3 times by whitewash.

1 Introduction

Disinfection is an integral part of the general program for the prevention and control of infectious and invasive diseases in agricultural enterprises. This is explained by the fact that long-term operation of livestock buildings leads to the accumulation of pathogenic and conditionally pathogenic microorganisms, viruses and fungi [1,2,3]. An important role in the prevention of diseases common to animals and humans is played by the creation and use of effective means aimed at destroying the vital activity of microflora that accumulate in the external environment, as well as improving the environmental situation in livestock and poultry farms [4,5,6,7].

Currently used for disinfection and disinvasion products containing chlorine, organophosphorus compounds, hydrogen peroxide, formaldehyde, sodium hydroxide, creolin, phenol, etc., which are highly toxic, volatile, have carcinogenic properties and are environmentally hazardous to the environment and vegetation, soil, water resources, etc. [8-11].

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A promising direction in the development of environmentally friendly disinfectants is the creation of 2 - 3-component formulations with a synthetic effect on the microbial cell. Similar products are not only effective and less toxic, but also decompose in the environment into harmless components [12,13,14,15].

The object of this type is Penox-1 with a content of 20.0% slaked lime, 3% sodium chloride and 5% foaming agent.

2 The purpose of the study

To study the physicochemical and disinfecting properties of the solutions of the Penox-1 preparation and to develop the technology and application modes for sanitizing livestock objects on various surfaces (smooth, rough) in laboratory conditions.

3 Materials and research methods

Since hydrated lime Ca (OH) 2 is a slightly soluble base in water, in all cases the use of lime suspension in veterinary practice in the right ratio of dissolved and undissolved particles is not an unimportant factor. This is because the dissolved Ca (OH) 2 molecules, being a strong electrolyte, completely dissociate in water according to the equation: Ca (OH) 2 = Ca2 + OH- and exist in solution in the form of ions, while most of the hydroxide calcium remains in molecular form and is the solid phase of a heterogeneous system. That is why the study of the solubility of slaked lime in a supersaturated solution is of great practical interest in wet disinfection at livestock facilities.

At the initial stage, the temperature dependence of the solubility of slaked lime in water was established. It was determined by the change in the activity of OH– ions as the temperature of a supersaturated slaked lime solution increased. Distilled water was used as a solvent.

The activity of OH– ions in the solution was contaminated with a Cheker pH meter (pH measurement limits –0-14, accuracy ± 0.2 pH), while the solution was slowly heated from 20 °C to 100 °C. The exposure time at each fixed temperature was at least 1.5 hours, with sufficiently intensive stirring. The temperature dependence was studied at the following indicators: 20 °C, 50 °C, 70 °C, 100 °C.

The solubility of the drug in water is expressed by the number of grams per 100 l of solvent giving a saturated solution at a given temperature.

At the same time, the solubility of 20% slaked lime was studied by adding 1.0, 3.0, 5.0, and 10.0% sodium chloride to it.

The solubility of hydrated lime depending on the temperature of water and sodium chloride was studied according to the methodology “On the test procedure for new disinfectant solutions for veterinary practice”, approved by the General Directorate of Veterinary of the USSR State Agricultural Committee, January 1987.

Laboratory tests of the disinfection efficiency of 20% slaked lime with sodium chloride and a foaming agent were carried out on smooth (stainless steel, galvanized iron, tile) and rough (concrete, wood) surfaces measuring 10 x 10 cm.

The test cultures used test cultures: E. coli (pcs. 1257), St. aureus (pcs. 209P), Mycobacterium (pcs. B-5) and Bac. cereus (piece 96).

To simulate the natural contamination of the test surfaces, inactivated horse serum was used, which was applied to the test surface at the rate of 0.5 ml / 100 cm2.

When developing disinfection regimes, test-culture-combined test-surfaces were arranged horizontally and vertically. Disinfection was carried out by the irrigation method,
at a consumption rate of 0.25-0.3 l/m² for smooth surfaces, 0.5 l/m² for rough surfaces, and exposure times of 1.3 and 24 hours. All studies were performed in triplicate.

The quality of disinfection was controlled by examining washes from experimental and control test surfaces for the presence of a given test culture.

The concentration of the solution of the compositions was considered effective, which, according to the results of at least three experiments, provided for the disinfection of all test surfaces used in the experiments in the presence of growth in crops from control test surfaces.

4 The results obtained and their discussion

Table 1 shows the results of experiments on the solubility of slaked lime in water. The results of the experiments showed that with an increase in the temperature of a supersaturated Ca (OH) 2 solution, the activity of OH– ions significantly decreases, which indicates a decrease in the solubility of hydrated lime in water.

| No. | Temperature, C° | pH | Solubility | Ca (OH) 2 / 100ml H2O, gr. |
|-----|-----------------|----|------------|-------------------------|
| 1   | 20              | 12.0 | 0.173     |
| 2   | 50              | 11.5 | 0.147     |
| 3   | 70              | 11.3 | 0.115     |
| 4   | 100             | 10.8 | 0.09      |

Thus, the most optimal temperature for dissolving slaked lime is up to +20 °C. The higher the temperature limit, the lower the solubility.

It is also known that the solubility of a sparingly soluble electrolyte increases when it is introduced into a solution of strong electrolytes that do not have ions of the same name. Table 2 shows the solubility results of slaked lime with the addition of 1,3,5 and 10% sodium chloride.

| Compositio n number | The name of the composition | Sample of lime and sodium chloride, column | The mass of the dried filter before filtering, column | The mass of the dried filter cake, column | The mass of insoluble precipitate column | The amoun t of sol shake lime column | % solubilit y |
|---------------------|-----------------------------|--------------------------------------------|--------------------------------------------------|----------------------------------------|----------------------------------------|-------------------------------------|--------------|
| 1                   | Slaked lime                 | 1.0                                        | 2.069                                            | 2.896                                  | 0.827                                  | 0.173                               | 17.3         |
| 2                   | Slaked lime + sodium chloride | 1.0+1.0                                   | 2.064                                            | 2.692                                  | 0.628                                  | 0.372                               | 37.2         |
| 3                   | ---«----                   | 1.0+3.0                                    | 2.059                                            | 2.672                                  | 0.620                                  | 0.380                               | 38.0         |
| 4                   | ---«----                   | 1.0+5.0                                    | 2.043                                            | 2.736                                  | 0.693                                  | 0.307                               | 30.7         |
| 5                   | ---«----                   | 1.0+10.0                                   | 2.056                                            | 2.797                                  | 0.741                                  | 0.259                               | 25.9         |

The table shows that the solubility of lime in 100 ml of water was 0.173 g. or 17.3%, when slaked lime 1 and 3 gr are added to the solution sodium chloride solubility increases, respectively, by 37.2 and 38.0%, i.e. 2.15 and 2.2-fold increase in solubility. At the same
time, with the addition of 5.0 and 10.0% sodium chloride, the solubility of slaked lime began to decrease, i.e. the reverse reaction of reducing the ionic strength of the solution occurs. The experimental results showed that when slaked lime 1 and 3% sodium chloride is added to a saturated solution, the ionic strength of the solution increases, which leads to an increase in solubility.

In subsequent experiments, the disinfecting properties of hydrated lime with sodium chloride were studied at the rate of 1.3 and 5% in 20.0% hydrated lime on test cultures contaminated on smooth and rough test surfaces.

Table 3. The results of experiments on the disinfection of test surfaces contaminated with E. coli (pcs. 1257) with solutions of 20.0% hydrated lime with sodium chloride and the addition of 5% foaming agent (PO-3A).

| No. | Composition | Composition of irrigation | Exposure hour | Consumption of disinfectant l/m² Test Surface | Test - Surfaces |
|-----|-------------|---------------------------|--------------|---------------------------------------------|----------------|
| 1   | 20% slaked lime and 5% foaming agent once | once | 3 | 0.25-0.5 | Stainless Steel: +, Galvanized Iron: +, Tile: +, Wood: +, Concrete: + |
|     |             | 24 | 0.25-0.5 | +, +, +, +, +, +, +, +, + |
|     |             | twice | 3 | 0.25-0.5 | +, +, +, +, +, +, +, +, + |
|     |             | 24 | 0.25-0.5 | +, +, +, +, +, +, +, +, + |
|     |             | three times | 3 | 0.25-0.5 | - - - +, + |
|     |             | 24 | 0.25-0.5 | - - - - - |
| 2   | 20% slaked lime, 1% sodium chloride and 5% foaming agent | once | 1 | 0.25-0.5 | Stainless Steel: +, +, +, +, +, +, +, +, +, + |
|     |             | 3 | 0.25-0.5 | - - - +, + |
|     |             | 24 | 0.25-0.5 | - - - - -, - - - - - |
| 3   | 20% slaked lime, 3% sodium chloride, 5% foaming agent | once | 1 | 0.25-0.5 | Stainless Steel: +, +, +, +, +, +, +, +, +, + |
|     |             | 3 | 0.25-0.5 | - - - - -, - - - - - |
|     |             | 24 | 0.25-0.5 | - - - - -, - - - - - |
| 4   | 20% slaked lime, 5% sodium chloride and 5% foaming agent | once | 1 | 0.25-0.5 | Stainless Steel: +, +, +, +, +, +, +, +, +, + |
|     |             | 3 | 0.25-0.5 | - - - - -, - - - - - |
|     |             | 24 | 0.25-0.5 | - - - - -, - - - - - |
| The control | Control distilled water, 5% foaming agent | once | 3 | 0.25-0.5 | Stainless Steel: +, +, +, +, +, +, +, +, +, + |
|     |             | 24 | 0.25-0.5 | +, +, +, +, +, +, +, +, + |

Note: (-) - disinfected; (+) - not disinfected.
The table shows that 20% hydrated lime with a 5% foaming agent does not disinfect E. coli with single and double irrigation. Destruction of Escherichia coli occurs upon triple irrigation, at the rate of 0.25 - 0.3 l / m² - for smooth and 0.5 l / m² - rough (concrete, wood) surfaces, respectively, for 3 and 24 hours of exposure.

At the same time, when 1% sodium chloride is added to a 20% hydrated lime with a 5% foaming agent, disinfection of Escherichia coli occurs with a single irrigation of smooth surfaces for 3 hours of exposure, at a rate of 0.25 - 0.3 l / m², rough - in 24 hours, at the rate of 0.5 l / m². With the addition of 3% sodium chloride, disinfection of Escherichia coli occurs on smooth surfaces in 1 hour of exposure, rough - in 3 hours. Increasing the concentration of sodium chloride to 5% does not lead to an increase in the disinfection effect.

Table 4 shows the results of the test disinfection test for contaminated St. aureus (pcs. 209P), solutions of 20% slaked lime, sodium chloride and 5% foaming agent.

| No. | Composition | Composition of irrigation | Exposure hour | Consumption of disinfectant l / m² Test - surface | Test - Surfaces |
|-----|-------------|--------------------------|---------------|-----------------------------------------------|----------------|
| 1.  | 20% slaked lime and 5% foaming agent once | once | 3 | 0.25 - 0.5 | + + + + + |
|     |          | 24 | 0.25 - 0.5 | + + + + + |
|     |          | twice | 3 | 0.25 - 0.5 | + + + + + |
|     |          | 24 | 0.25 - 0.5 | + + + + + |
|     |          | three times | 3 | 0.25 - 0.5 | + + + + + |
|     |          | 24 | 0.25 - 0.5 | + + + + + |
| 2.  | 20% slaked lime. 1% sodium chloride and 5% foaming agent | once | 1 | 0.25 - 0.5 | + + + + + |
|     |          | 3 | 0.25 - 0.5 | - - - + + |
|     |          | 24 | 0.25 - 0.5 | - - - + + |
| 3.  | 20% slaked lime. 3% sodium chloride. 5% foaming agent | once | 1 | 0.25 - 0.5 | + + + + + |
|     |          | 3 | 0.25 - 0.5 | - - - - - |
|     |          | 24 | 0.25 - 0.5 | - - - - - |
| 4.  | 20% slaked lime. 5% sodium chloride and 5% foaming agent | once | 1 | 0.25 - 0.5 | + + + + + |
|     |          | 3 | 0.25 - 0.5 | - - - - - |
|     |          | 24 | 0.25 - 0.5 | - - - - - |
The control distilled water, 5% foaming agent.

| Test control |  |  |  |  |
|--------------|---|---|---|---|
|  |  |  |  |  |

Note: (-) - disinfected; (+) - not disinfected.

The table shows that the 20% slaked lime does not disinfect Staphylococcus aureus contaminated on various test surfaces under three irrigation during 3 and 24 hours of exposure, from the calculation of 0.25 - 0.5 1 / m2. Disinfection occurs when 1% sodium chloride is added on smooth surfaces during 3 hours of exposure at the rate of 0.25-0.3 1 / m2, and rough when 3% sodium chloride is added after a single irrigation during 3 hours of exposure at the rate of 0.5 1 / m2. Thus, the disinfection of pathogens of infectious diseases of I - II resistance category occurs when 5% foaming agent and 3% sodium chloride are added to 20% slaked lime (the conventional name of the drug is Penox-1), at the rate of 0.5 1 / m2 for 3 hours of exposure.

The effect of Penox-1 solutions on mycobacteria (pcs. B-5) and Bac spores was studied. cereus (piece 96).

Table 5 shows the results of experiments on the disinfection of mycobacteria (pcs. B-5) on test surfaces (concrete, wood).

Table 5. The results of experiments on the disinfection of Mycobacterium (pcs. B5) on the test-surface with solutions of the Penox-1 preparation.

| Composition of the composition | Disinfectant consumption 1 / m2 | Exposition hour | Multiplicity of irrigation | Test - surface |
|-------------------------------|---------------------------------|-----------------|---------------------------|---------------|
|                               |                                 |                 |                           | Concrete | Wood |
| 20% slaked lime, 3% sodium chloride, 5% foaming agent | 0.5 | 1 | one-time | + | + |
| | | 3 | + + + + + |
| | | 24 | + + + + + |
| -----<------ | 0.5+0.5 | 1 | twice | + | + |
| | | 3 | + + + + + |
| | | 24 | + + + + + |
| Control | distilled water and 5% foaming agent | 3 | + | + | + |
| | | 24 | + | + | + |

Note: (-) - disinfected; (+) - disinfected.

The experiments showed that the disinfection of mycobacteria occurs with Penox-1 solutions with double irrigation at the rate of 0.5 1 / m2 for each irrigation with an interval of 1 hour, with an exposure of 24 hours.

The results of experiments on the disinfection of spores Bac. cereus (pcs. 96) showed that solutions of Penox-1 agent for Bac spores. cereus (pcs. 96) do not work with double irrigation at the rate of 0.5 1 / m2 z.A for 24 hours of exposure.

**5 Conclusion**

Studies have found that the solutions of the new Penox-1 disinfectant disinfect infectious disease pathogens of I - II resistance category at a rate of 0.5 1 / m2 at 3 hours exposure, III category of resistance at double irrigation, at a rate of 0.5 1 / m2 for each irrigation, with
exposure - 24 hours. The addition of 3% sodium chloride to 20% slaked lime increases the solubility 2.2 times.

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