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BOOK 5

"MATHEMATICS, INFORMATICS AND PHYSICS"

VOLUME 12

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BOOK 5

"MATHEMATICS, INFORMATICS AND PHYSICS"

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RADIOLOCATION PARAMETER DETERMINATION OF BLASTING MATERIALS

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Abstract: *In the modern world, the secret services pay more and more attention to the fight against terrorism. Self made devices which contain powders with phosphorus, with and without phlegmatizers are often used. In the present work some specific characteristics of dangerous materials are considered (with throwing and blasting action) and also apparatus are offered and instruments for radiolocation characteristics detection of such dangerous substances. This gives an opportunity for their nondestructive analyzing, aiming to prevent their possible usage.*

Keywords: *radiolocation characteristics, explosive materials, incendiary action, phlegmatizers, nitro-cellulose powder.*

INTRODUCTION

Events in recent years show convincingly that terrorism has become one of the most serious threats to the public life. The arena of the terrorism extends to all continents. Analysts emphasize that terrorism in its characteristic is a global and continuous system of threats. For this reason, the fight against terrorism is one of the main tasks of the special services of the different countries [11], [12], [13], [14]. Terrorist actions as a rule have a demonstrative character. The purpose is to attract the public attention and mass media, to frighten and cause panic among the population or to force a government or an international organizations to take specific actions. To achieve their purpose, terrorists use different techniques: setting on fire, bombings and shootings, hostage-taking, kidnapping and other violent acts. Specialists in fighting against terrorism believe that the rising of the terroristic threats can be limited by an overall system of organized precautions. They include complex usage of special technical resources [5], [8], [9], [10], [15], [16], [17], [18].

SPECIAL TECHNICAL RESOURCES COUNTERACTING TERRORISM ATTACKS

- **Technical resources and systems which provide object defense by their visual perceptions:**
  - Optical magnifying devices (magnifiers, borescopes, videoscopes and others)
  - TV visual systems
  - Night vision devices
  - X-ray television systems
- **Technical resources and systems which provide object defense by signs, related to the properties of materials and substances** (electric conductivity, magnetic or dielectric permittivity, chemical composition, presence of nonlinear electromagnetic properties and others):
  - Metal detectors
  - Devices for nonlinear radiolocation
  - Devices for ultrasonic echolocation
  - Detectors of drugs and explosives
  - Device for control of the radiation environment
- **Technical resources and systems which provide object defense by sign, containing electromechanic devices:**
  - Devices detecting radio broadcasting
  - Electromagnetic radiation

- Acoustic signals and others

- **Complex systems which provide joint functions and capabilities of two or more devices in united system**:
  - Metal detectors with in-built sensor for ionizing radiation
  - Mobile robotic complexes
- **Counterterrorism resources – silencers of remotely explosive devices - blockers**

It is known that the most attractive places for terrorist attacks are places where many people are gathered. Such places are: train stations, airports, theatres, big sport and concert halls, hospitals, schools, air and marine vessels, government offices and military areas.

These places must be backed up by equipment which will help the safety services to take precautions against terroristic attacks. For this purpose, a check for existence of dangerous materials must be made.

Different special services (SS) use variety of forms for preventing an attack. The Russian SS use system “CONTOUR”, which serves to observe people and luggage, aiming to detect weapons and dangerous objects. This system is used on the borders to prevent contraband actions, at the train stations and airports to secure the passengers’ safety, in mines and factories for diamond and gems. The product has different modifications and changes like “CONTOUR-S”. The modifications can be placed in a wall, under a roof, etc. The scan is done using a flat beam. The resolution in low-contrast objects is from one to 5 millimeters, and in contrast objects the resolution is 0.2 mm [19], [20].

Similar miniature portable device is „NORKA”. The resolution is 0.4 mm. It can detect explosive kits (blast, detonator, cord).

For weapon and dangerous objects detection, the European Special Forces use products of “GARRETT MAGNASCANNER” company. The devices have wide area of modifications, working with performance of one scan in second, in working temperature from 20 ^{0}C to 70 ^{0}C. There is an infrared barrier in some of the modifications. The British Special Forces use also a portable metal detector of type “SAHINX” with different modifications. They are in full compliance with the international certificates NILECJ-0601 R 3-GUNTEST (FAA-USA) [7], [8].

Terahertz waves (THz, T-ray) are in the range of infrared electromagnetic spectrum with range from 0.1 to 10THz. Chinese specialists had constructed systems for dangerous materials detection in this range. In compare with the common detecting methods these methods do not generate ionization and are not dangerous for the stuff. Detection with laser probing signal can be made in real time. Combination of laser emitter with 10ns pulse and modern pattern explosive detection recognition is used [21], [22], [23].

GENERAL INFORMATION FOR EXPLOSIVES

Blast, in the broadest sense of the word, is an extremely fast physical or chemical amendment of substance, accompanied with also rapid conversion of its potential energy in mechanical work for operation or destruction [4], [6].

The most significant characteristic of the blast is the sudden and sharp rise in pressure of the area which surrounds the place of explosion. The outer sign is a significant sound effect, which comes after the blast. Typical examples for this phenomenon are the blasts of specific materials, called explosives. They are unstable systems which under the influence of slightly external effects are capable of many rapid chemical transformations accompanied with calorification and forming of heated gases which can perform work. [2], [3].

The blast is categorized with three main factors – its high transformation speed, exothermicity and existence of gas products.

The most typical is the first, i.e. the extraordinary transience of the process, which is measured by hundredths to millionths of a second. For example the explosion time of 1 kg of dynamite is only 0.00002 seconds. This explains the enormous, compared to other sources of energy, power of explosives, although the common storage of energy for unity of weight contained in them is almost always smaller, rather than the ordinary combustibles. At the same time, the concentration of energy (for a unity of volume from the explosive material) in solid and liquid explosives are considerably bigger than in the normal cumbustibles [4], [5], [6].

We can get the idea for the power of explosives, taking into advantage that relatively weak explosive as the smokeless powder, when blasting 1 kg performs a work corresponding to a machine with power 20 million hp. This number is estimated by calculating the whole amount of heat, separated during the explosion, which is turned into work, but in reality this isn't true.

Without the second factor, i.e. without the exothermicity of the process, a blast is not possible. The heat separated during the explosion characterizes the potential energy of the blasting material. The speed of the blasting reaction and the high pressure of the gas products in the place of explosion depend on the reaction heat.

Exothermicity of the transformation is necessary but not sufficient condition for the process to be characterized as a blast. This can be concluded by series of examples. One of them is the thermal reaction $2Al+Fe_2O_3=Al_2O_3+2Fe+198$ cal., passing without blast, even though the temperature rises up to 3000°, and as a result not only the iron but aluminum oxide transforms into liquid condition.

In order for the transformation to be explosive, the exothermicity must be combined with existence of gas products in the blast, which due to the high heating fast expansion convert the thermal energy into mechanical work.

The volume of the formed gases after the blast from the ordinary explosives, brought to normal conditions, are approximately expressed by the following numbers [2], [6]:

Table.1. Amount of gaseous products formed by explosives

	from 1 kg explosive l.	from 1 l explosive l.
Gunpowder smoke	280	336
Pyroxylin	765	994
Nitroglycerin	715	1144
Picrid acid	690	1141
Trinitrotoluol	685	1104

Therefore from 1 litre ordinary explosives are formed approximately 1000 litres of gas products. The listed factors, characterizing the blasting process for the different explosives may have different numeric meanings even for the same explosive, depending on the impermanent conditions. In most dramatic form this appears in the pace of the process – depending on the different conditions, the duration of the blasting transformation for 1 kg of kinds of substances may vary from hundredths to hundred-thousandths of a second.

According to the speed of the process, the blasting transformation can last in different form. It may have either faster or slower burning or of an actual explosion with its corresponding effect, or of so called detonation, which is accompanied with maximum destructive action [4], [5].

Fast burning of explosive is called the process of transformation which flows with speed up to several meters in a second and is under big influence upon external conditions. When it is done outside, the process usually is not accompanied by some significant sound effect and sometimes carries the title deflagration. In closed doors, for example the charging chamber of the gun, this process flows with sharp sound. The action in the last case is characterized with faster or slower increase of gas pressure, and performing work for moving or shifting in the direction of least resistance.

The actual blast is a process, which flows with variable speed, it is measured in hundredths and sometimes in thousands meters in second and does not depend so much on the external factors. The action here is characterized with sharp pressure increase on the place of explosion, with a kick by the gases on the environment and with work performing for breaking and fragmenting of relatively close objects.

Detonation is the process which is spread over the substance with constant maximum possible for given conditions speed, normally measured in thousands meters in second. The magnitude of this speed represents specific for the given conditions constant of the explosive. The action in detonating is described as particular sharp pressure peak and kick of gases, which is accompanied by maximum for the given conditions destructive effect.

CLASSIFICATION OF BLASTING PROCESSES

The great diversity of explosives suggests different approaches for classification.

One explosive classification approach is in their practical application. According to this classification, the explosives are divided in four big groups:

- initiating;
- blasting;
- powders;
- some pyrotechnics.

Initiating explosives are used mainly for equipping of different capsules –initializers of blasting processes. Their blasting transformation is caused by relatively insignificantly mechanical or heat external impact and is distinguished with shortest period for maximum speed increasing.

The most important members of this explosive group are:

- blaring acid salts with heavy metals, for example fulminate of Hg $(ONC)_2$;
- salts of hydrazoic acid with heavy metals – for example lead acid PbN_6;
- salts of styphnic acid and picric acid with heavy metals or also called styphnics and picrates – for example lead styphnate $C_6H(NO_2)_3O_2Pb$;
- capsule – detonating and flammable – kick ingredients mainly related to the basis of fulminate of mercury, potassium chloride and antimony.

Blasting materials are used for equipping shells, aviation bombs and various munitions and for making subversive charges. They are designed for obstacle destruction and any sort of other aims. Their blasting transformation form is principally detonation, which is caused by more significant external impact rather than it is needed for the initializing blasting materials.

The most important members of this group are the following blasting materials:

Uniform:

- Nitrates or esters of nitric acid; nitroglycerin $C_3H_5(ONO_2)_3$; pentaeritrittetranitrat (nitropenta) $C(CH_2ONO_2)_4$; cellulose nitrate (pyroxylin, collyxylin) $C_{24}H_{29}O_9(ON02)_{11}$, $C_{24}H_{31}O_{11}(ONO_2)_9$ and others; Listed exploding materials, except the ten, are used generally for preparation of smokeless powders and dynamite;
- Nitrocompaunds mainly from aromatic row, for example trinitrotoluol (TNT) $C_6H_2(NO_2)_3CH_3$; trinitrophenol (melinit, picrid acid) $C_6H_2(NO_2)_3OH$; trinitrofenilmetilnitramin (tetryl) and others.

- Some nitroderivatives of benzene and naphthalene, for example dinitrobenzene $C_6H_4(NO_2)_2$ and dinitronaphthalene $C_{10}H_6(NO_2)_2$.
- Some nitro compounds form non aromatic row, for example trimetiletrinitraminat or hexogen $C_3H_6N_6O_6$ — powerful blasting material.

Non-uniform:

- Dynamits or nitroglycerine explosive materials, contain 88%÷93% nitroglycerin and 12%÷7% colloxylin.
- Ammonium nitrate explosive mixtures, for example amatolat, contain 80% ammonium nitrate and 20% trotyl, or amonal containing 82% ammonium nitrate, 12% xylyl and 6% aluminum.
- Oxyliquids - different dust absorbators, inked with liquid oxygen.

Gunpowders are used primarily as propelling charges for different types of firearms. Predominant type of their exploding transformation is the fast burning, caused by the help of flammable ingredients.

Gunpowders are separated into two big subgoups: gunpowders – mechanical compounds and gunpowders – colloidal type.

To the first subgroup the smoke or black powders are related, representing a mechanical compounds of saltpeter, sulphur from saltpeter, sulphur and coal – for example artillery and gunpowder smoke, which contain 75% potassium nitrate, 10 % sulphur and 15% coal.

Gunpowders from the second subgroup represent pyroxylin, gelatiniran – brought into colloidal state with one or another solvent (volatile, hard to volatile or non volatile). They include:

- Pyroxylin gunpowder, containing 95,7% pyroxylin, 2% strong ethereal solvent, 1% diphenylamine and 1,3% moisture. The powders of this type are called non smoking pyroxylin powders.
- Balistit — powder with hard volatile solvent, containing 20%÷28% nitroglycerin, 70%÷68% soluble pyroxylin and 10% other substances.
- Cordite, containing 35% insoluble pyroxilin, 58% nitroglycerin, 5% vaseline, 1.5% extra solvent (acetone) and 0.5% moisture.

The last two types of non smoking powders are sometimes called nitroglycerine smokeless gunpowders.

Pyrotechnics (incendiary, illuminators, signals and tracing), which are used for special ammunitions, represent mechanical compounds of oxidizers and combustibles. Under ordinary conditions of use, these compositions give in burning the pyrotechnic effect (illuminating, incendiary and others).

Many of these compositions possess explosive materials and under certain conditions can detonate such as containers of signal lights, which contain chlorate, serving as oxidizers.

The main requirements for the blasting materials which have practical application are:

- enough energy and power, providing the needed throwing action and destructive effect;
- defined borders of sensitivity towards external actions, providing, in one way, safety in use, and in other – easy excitation of the blast;
- ability for more or less time to preserve unchangeable physico-chemical, and hence the explosive properties;
- a number of special requirements, mainly to physical (non-hygroscopicity, fixity, insolubility, density and others) and the blasting properties (progressiveness of gunpowder, safety of blasting explosives in a shot or shooting with a bullet, harmlessness of the explosion products for underground works and others).

DETERMINATION OF BLASTING MATERIAL ABSORPTION

- ***Used equipment -SPEKOL***

The spectrophotometer is constructed to work on every flat and solid surface. It is recommended that the power source to be about two meters from the place where the device will be used. The place must be clean, away from direct sunlight, airflows, at a relatively constrant temperature and without electrical influences.

Surrounding temperature must be from 10° to 35°C.

The relative humidity should be under 80% for temperatures up to 30°C and lower than 65% for temperatures above 30°C.

- ***Work with samples – choosing a cuvette (secondary vial, in which is placed the sample)***

The particular choice depends on the number of different factors – like the wavelength, expected transmittance, sample size.

The material from which the cuvette is made is determined by the wavelength. For measurements under 360 nm quartz cuvettes are needed to be used and for measurements above 360 nm glass cuvettes can be used. The transmittance of the empty cuvettes is:

>80% T 360 - 2500 nm for optical glass

>80% T 200 - 2500 nm за UV glass

The spectrum of the sample is shown graphically by measuring the change in absorption with wavelength.

When the wavelength is scanned, the overall energy characteristic (sensitivity) of the apparatus is changed, even when there is no sample. This change is measured and compensated by the process of saving the basis line, which must be done before sample scanning.

In order to obtain the spectrum of the sample in solution, first is saved the basis line only with solvent in the cuvette. Such cuvette is often called control cuvette of empty cuvette and must have the same optic length of the line like the cuvette which will contain the sample, dispersed in the solvent. Later the cuvette containing the sample is scanned by a beam and the spectrum is received automatically. For example, to receive spectrum of filter against air, the basis line is stored without sample in the beam. After that the filter is scanned to receive its spectrum.

The basis line disappears when the power supply is shut down.

- **Spectrum scanning**

The spectrum of the sample can be scanned in order to be shown on the screen of the diagram draw in any time after a suitable basis line was stored, as described in the previous section.

Spectrums, containing many details must be scanned much slower rather than spectrums which have only wide light absorption bands, which is typical for many liquid samples.

Choose the mode for scanning with the button **SCAN**, and later "**Scan Menu**", followed by "**Scan**" with cursor and button **ENTER**. On the screen will appear a list of questions asking to enter the parameter values, for example the initial point of wavelength, the end point of wavelength, the minimum light absorption, maximum absorption, scanning speed and others. The default values for every parameter are also shown on the screen. Enter the values using the keyboard and pressing the **ENTER** after requests. If no new value is entered, for every parameter is selected the default value and pressed **ENTER**. The scanning begins after pressing button **RUN** and is shown on the screen.

The button **RUN** can be pressed for scan initiating during the whole sequence and previous or default parameter values will be automatically used. The spectrum diagram can be printed by pressing **PRINT** button, when the scanning is finished,

When given scan is finished, press button **NEXT** and again on the screen will appear the message for new scan. New scans can be made using the same parameters without new inputs.

- **Auto Scale Scan**

After choosing the scan mode using **SCAN** button and choosing "**Scan Menu**", it may be selected in usual way this function by the buttons **UP**, **DOWN** and **ENTER**.

In "**Auto Scale Scan**" spectrums are show graphically on the screen or as a drawing on plotter with automatic range choice after they are scanned in the buffered memory.

The diagrams of the unknown spectrums can be drawn without scaling as it is known that they will be showed graphically with acceptable presenting of all peaks in the scale.

- **Reprocessing a Scan**

Each spectrum, shown on the screen, can be reworked, if it is needed, within the range of wavelengths of the original signal. The extent of absorption, wavelength range and scale of wavelength can be changed. It is possible a change from absorption to transmission spectrum.

- **Solvents**

The suitable solvent for use in ultraviolet area should dissolve our sample and at the same time must have minimum absorption level in the work area.

In spectrum range, where the solvent has high absorption level, there will be energy absorption in the comparative and analyzed samples, which leads to high noise values.

In the offered list is showed the bottom short wave border in which the solvent has absorption 1, i.e. oversight 10% when measuring in standard 10 mm cuvettes.

GOTO
↓
ENTER
↓
Absorption setting/READOUT
↓
Inserting a control sample
↓
ZERO
↓
Presentation of the results
↓
END

Fig.1. Algorithm for handling equpment SPEKOL for absorption coefficient determination

Table 2. Bottom shortwave border (nm) for used solvents

Water	19
Acetonitrile	21
Cyclohexane	21
Ethanol	21
Iso-Propyl Alcohol	21

Methanol	21
Methyl Cyclohexane	21
Dioxane	21
Hexane	21
Acetone	33

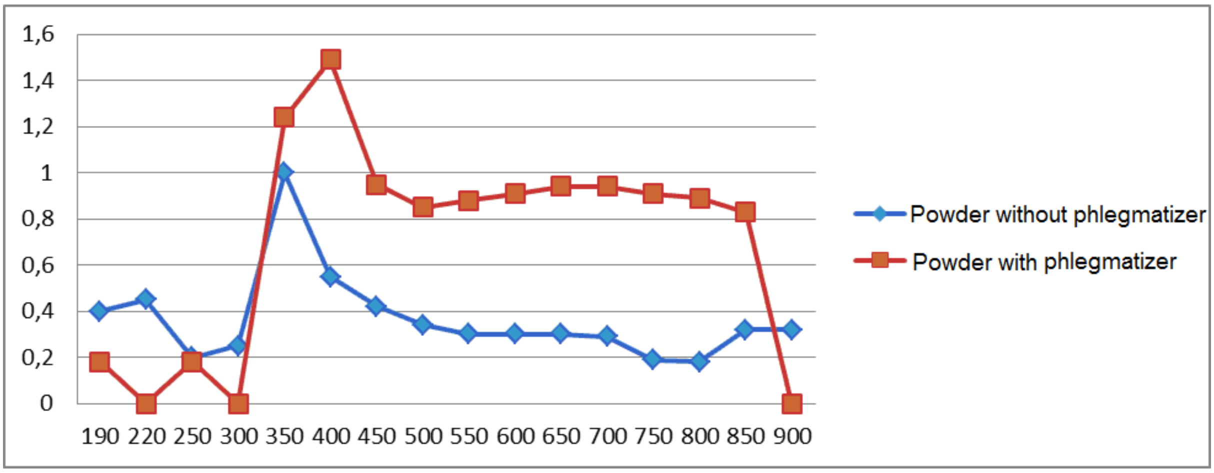


Fig.2. Absorption coefficient of powders without and with phlegmatizers at λ=190÷900 nm

The coefficients of powders with phlegmatizers are with higher values (40%-50%), in comparison to powders without phlegmatizers at wavelegth λ=300÷850 nm. The absorption coefficient decreases rapidly for powders with phlegmatizers at wavelength λ=900 nm.

DETERMINATION OF REFLECTIVE PROPERTIES OF BLASTING MATERIALS

General information for used equipment VCS-4

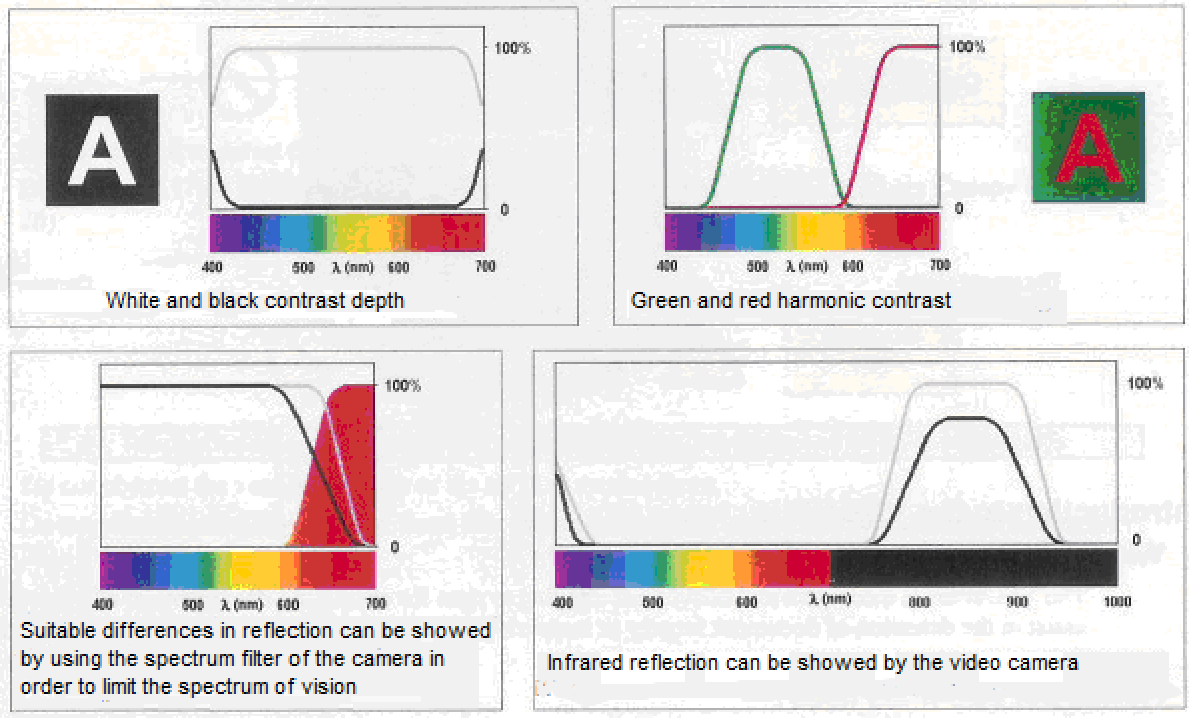
The used equipment VCS-4 consists of: control panel, stand for samples, transmitting and receiving detectors. To improve the reflective contrast different work modes of the light sources are used. The light can be refracted or reflected by the topology or microsctructure of the object at precisely determined angle.

Table 3. Exposure models in angular contrast of different samples

Lighting mode	Feature
C	The reflection of some object signs can be visible only if the light is at zero degree.
D	Vibrations in relief surface can be detected using shadows produced by lighting at bigger angle.
E	Holograms and other optical choosing devices can show different objects' details depending of the lighting angle.

Permeable contrast shows the different thickness of the examined object.

Table 4. Permeable contrast. Ultraviolet fluorescence. Visible fluorescence.



Ultraviolet fluorescence – the wavelength is λ=280 nm ÷320 nm. UV radiation is absorbed by the object and reemitted with long wavelength in the visible spectrum (380 nm ÷700 nm).

Visible fluorescence – suitable for some materials, a thin light beam is used.

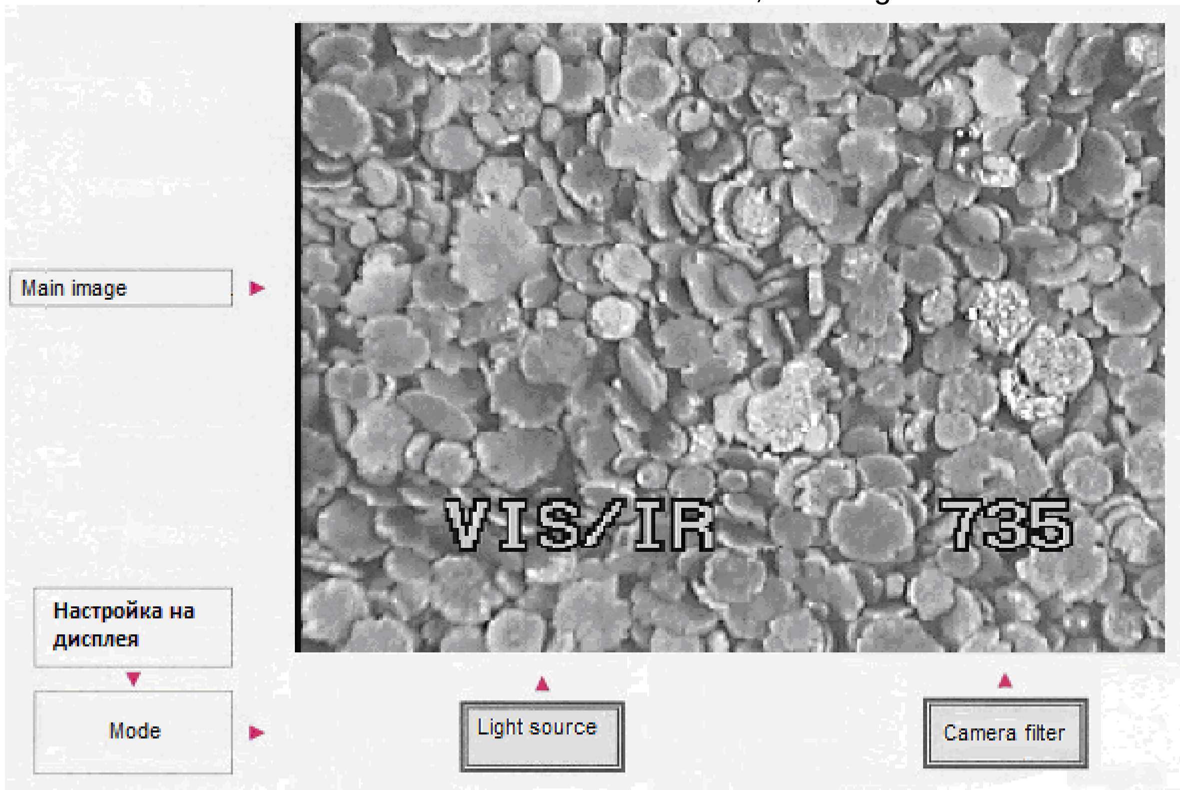


Fig.3. Input window of the used aparatus for reading reflective properties of the types of gunpowreds. Measurementt of pyroxylin (gunpowder)

- Main image
- Scale – scaling will depend on the dimensions of the monitor

- Orientation (turning up to 180)
- Color settings

On *Fig.4*. a block diagram is presented for working with and setting to VCS-4, used to detect reflective properties of three types of gunpowders – with sulphur, with phosphorus and nitrocellulose gunpowder.

Inserting the sample

↓

Menu – focus (1-125)

↓

IRIS (f1.4 – f22)

↓

Gain (-3 dB – 28 dB)

↓

INT (1/300 sec – 1 sec)

↓

LEVEL (0 – 9)

↓

MIRROR

↓

ROTATE (off or on)

↓

INCREASE (*1, *2)

↓

MONO (off or on)

↓

DELAY (0,1 sec – 9,9 sec)

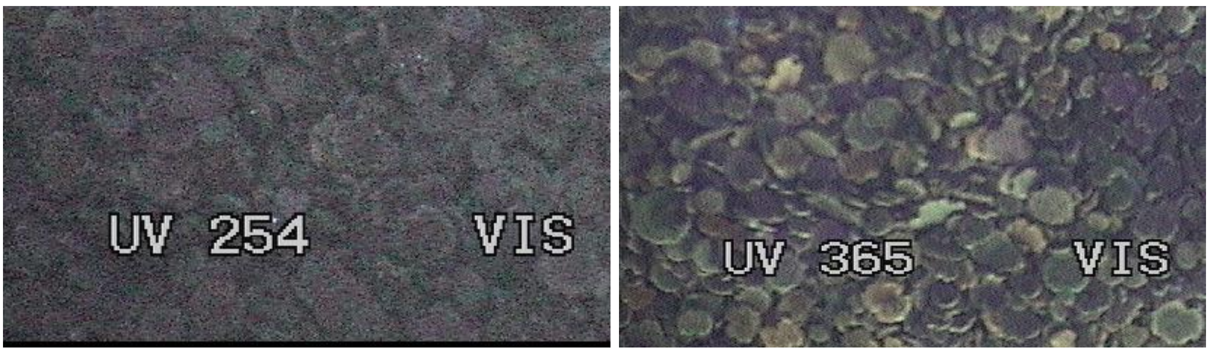
↓

EXIT

↓

END

Fig.4. Flowchart for configuring and working with video comparator VSC-4.



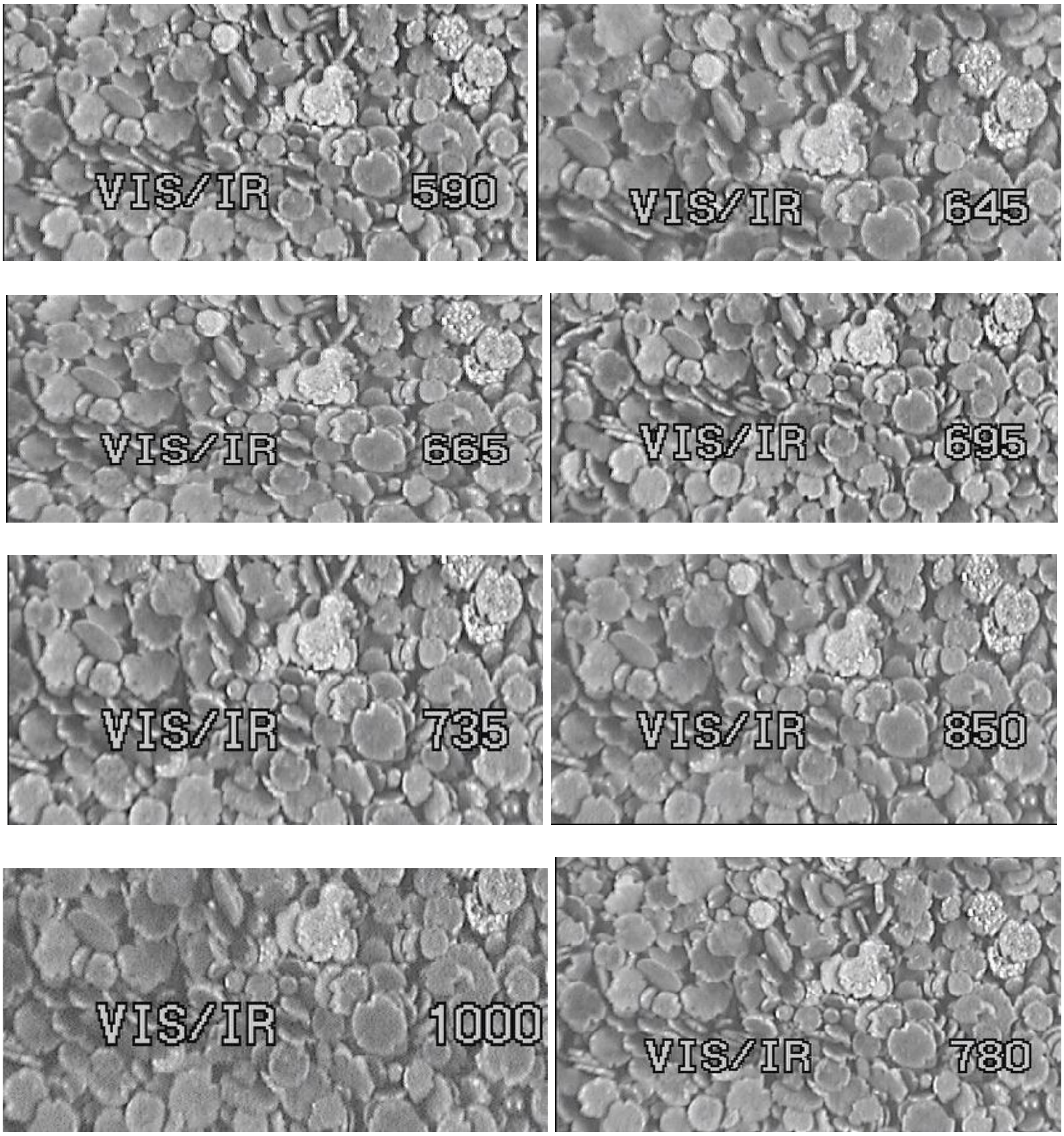
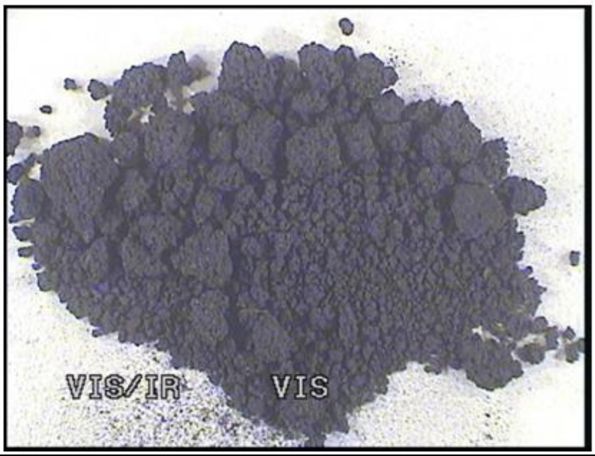
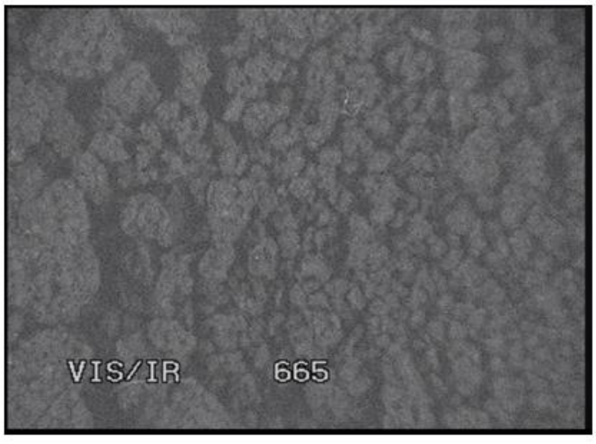


Fig.5. Received results in different wavelengths for nitrocellulose gunpowder

Received and processed results in MATLAB environment [1]

Sample 1 – Presence of sulphur (sulphur gunpowder)





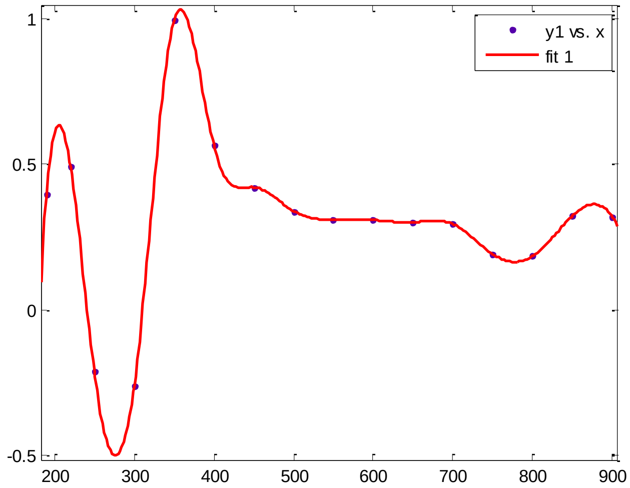


Fig.6. Cubic interpolation

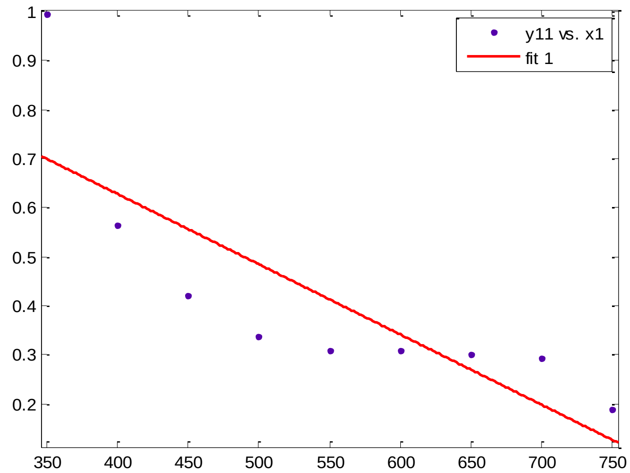


Fig.7. Linear approximation for reflective gunpowder properties with phlegmatizer and wavelength λ=350 nm ÷750 nm

Approximation: for lambda from 350-750nm
Linear model Poly1:
f(x) = p1*x + p2
Coefficients (with 95% confidence bounds):
p1 = -0.001434 (-0.002349, -0.0005193)
p2 = 1.202 (0.6855, 1.719)
Goodness of fit:
SSE: 0.1572
R-square: 0.6625
Adjusted R-square: 0.6143
RMSE: 0.1499

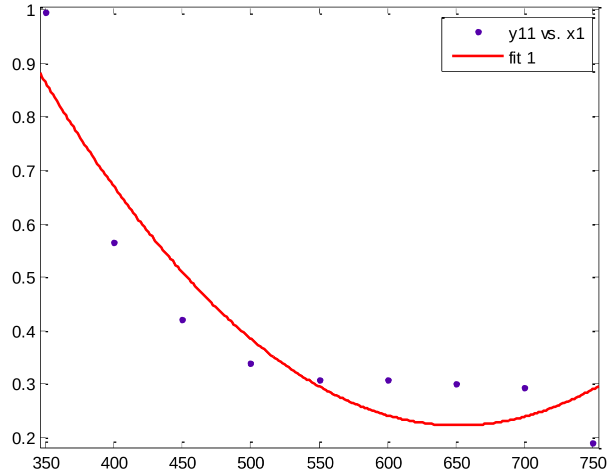


Fig.8. Quadratic approximation for reflective gunpowder properties with phlegmatizer (sulphur) and wavelength λ=350 nm ÷750 nm

Linear model Poly2:
f(x) = p1*x^2 + p2*x + p3
Coefficients (with 95% confidence bounds):
p1 = 7.041e-006 (1.38e-006, 1.27e-005)
p2 = -0.009179 (-0.01544, -0.00292)
p3 = 3.215 (1.557, 4.873)
Goodness of fit:
SSE: 0.06181
R-square: 0.8673
Adjusted R-square: 0.8231
RMSE: 0.1015

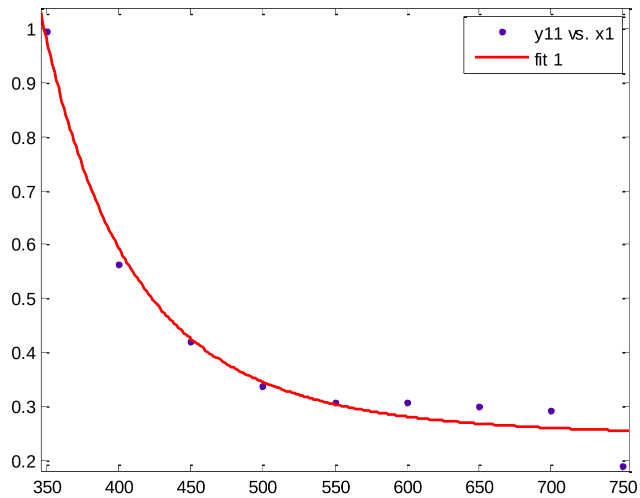
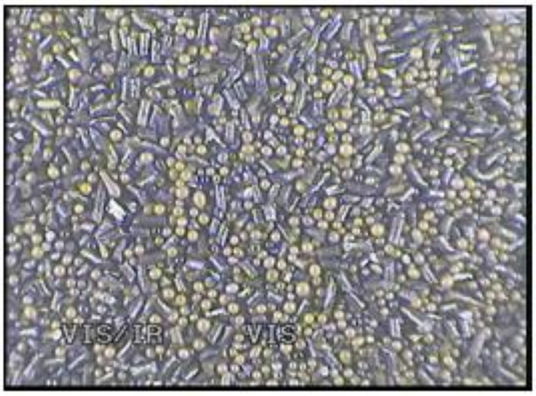


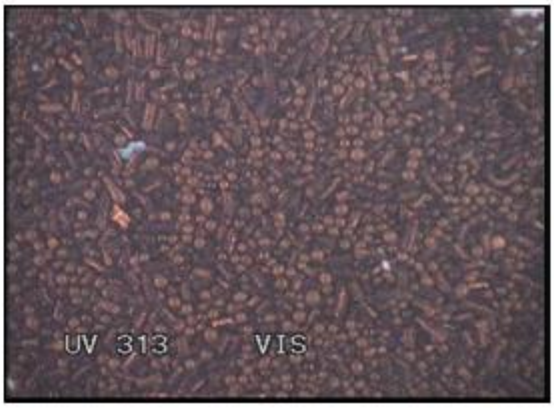
Fig.9. Cubic approximation for reflective gunpowder properties with phlegmatizer (sulphur) and wavelength λ=350 nm ÷750 nm

General model Power2:
f(x) = a*x^b+c
Coefficients (with 95% confidence bounds):
a = 1.126e+014 (-1.167e+015,1.392e+015)
b = -5.576 (-7.518, -3.633)

c = 0.2456 (0.1849, 0.3064)
Goodness of fit:
SSE: 0.008332
R-square: 0.9821
Adjusted R-square: 0.9762
RMSE: 0.03727

Sample 2 – Phosphorus presence (phosphorus gunpowder)





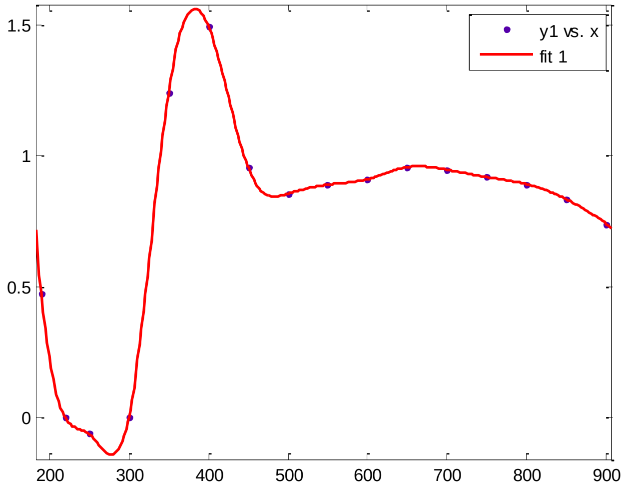
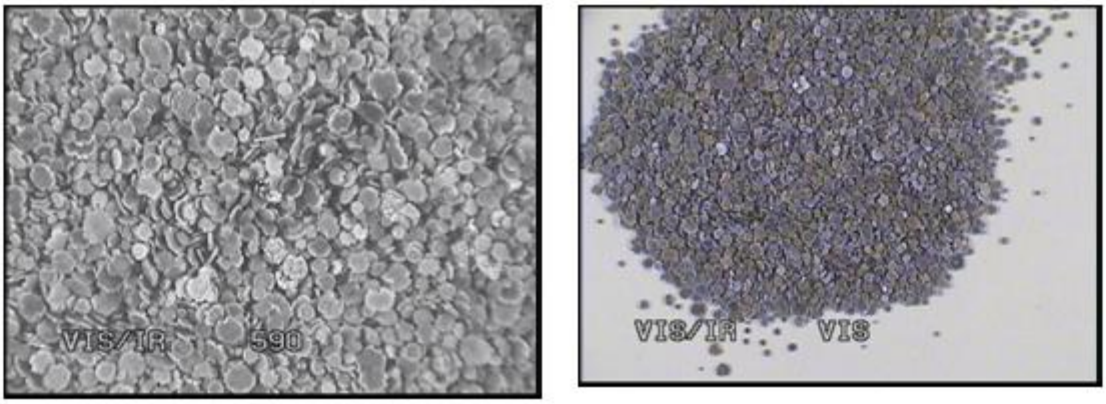


Fig.10. Cubic spline interpolation for the reflective properties of gunpowder with phosphorus and wavelength λ=350 nm ÷750 nm

Linear model Poly3:
f(x) = p1*x^3 + p2*x^2 + p3*x + p4
Coefficients (with 95% confidence bounds):
p1 = -1.376e-008 (-2.313e-008, -4.379e-009)
p2 = 2.582e-005 (6.793e-006, 4.484e-005)
p3 = -0.01579 (-0.02836, -0.003226)
p4 = 4.061 (1.361, 6.76)
Goodness of fit:
SSE: 0.004253
R-square: 0.8936
Adjusted R-square: 0.8404 , RMSE: 0.0266

Sample 3 – Nitrocellulose gunpowder



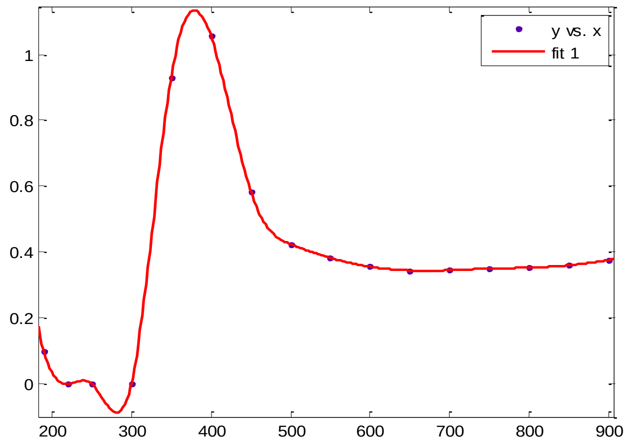


Fig.11. Approximation to the reflective properties of gunpowder without phlegmatizer (nitrocellulose) and wavelength λ=350 nm ÷750 nm

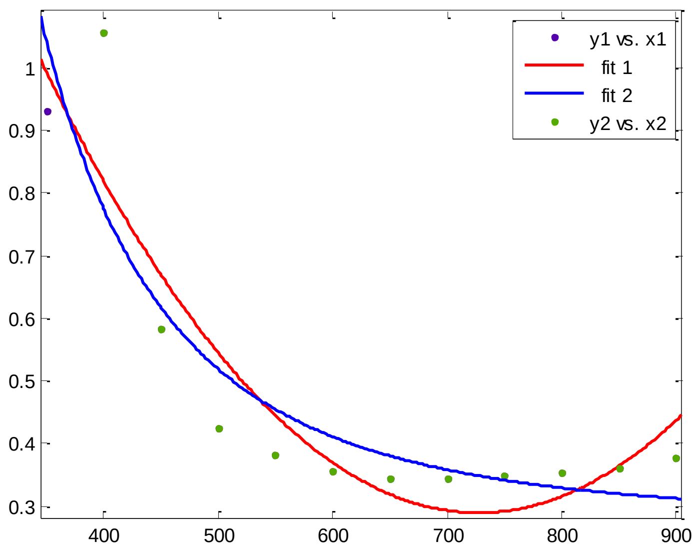


Fig.12. Approximation to the reflective properties of gunpowder without phlegmatizer (nitrocellulose) and wavelength λ=350 nm ÷750 nm

Degree of (blue – range 400-900nm; red 350-900nm)
Model for red:
General model Power2:
f(x) = a*x^b+c
Coefficients (with 95% confidence bounds):
a = 1.199e+008 (-2.135e+009, 2.375e+009)
b = -3.221 (-6.448, 0.006705)
c = 0.2757 (0.04528, 0.5061)
Goodness of fit:
SSE: 0.1178
R-square: 0.8232
Adjusted R-square: 0.7839, RMSE: 0.1144
Model for blue:
General model Power2:
f(x) = a*x^b+c
Coefficients (with 95% confidence bounds):
a = 8.046e+013 (-1.286e+015, 1.447e+015)
b = -5.41 (-8.245, -2.574)
c = 0.3053 (0.2247, 0.3859)
Goodness of fit:
SSE: 0.02864
R-square: 0.9369
Adjusted R-square: 0.9211 , RMSE: 0.05983

CONCLUSION

Regression models describing the reflectivity of individual works without phlegmatizer with 3 parameters and correlation above 80% should be linear.

Regression models of type $f(x)=a.x^{b+c}$ gives determination above 90% in describing the reflective variation of waves with λ=400 nm ÷900 nm of gun powders and phlegmatizers.

The presence of phosphorous in the composition of powder complicates the regression model (parameters are 4). For describing the change of reflective coefficient of signals with wavelength λ=400 nm ÷900 nm a polynomial of type $f(x)=p_1x^3 + p_2x^3 + p_3x + p_4$ is offered, which provides model adequacy above 85% .

The reflective properties of nitrocellulose propellant can be described with simple regression models of type $f\{x\}=ax^b +c$, which provides adequacy above 90% in wavelength λ=400 nm ÷900 nm.

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ОПРЕДЕЛЯНЕ РАДИОЛОКАЦИОННИТЕ ПАРАМЕТРИ НА ВЗРИВНИ ВЕЩЕСТВА

Валерий Джуров

Русенски университет "Ангел Кънчев"

Резюме: *В съвременният свят, специалните служби отделят все повече внимание на борбата с тероризма. Използват се често самоделни устройства, в които има наличие на барути с фосфор, с и без флегматизатори. В настоящата работа са разгледани специфични характеристики на опасни материали (с метателно и бризантно действие) и са предложени апарати и уреди за снемане на радиолокационните характеристики на такива опасни вещества. Това дава възможност за безразрушаващото им анализиране с цел превенция при евентуалното им използване.*

Ключови думи: *радиолокационни характеристики, експлозивни материали, запалително действие, флегматизатори, нитроцелулозен барут.*

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