The technology for production of these powders is simple and significantly differs from the conventional technologies. Powders will be made by mechanical milling of local mineral raw materials and do not require the modification with expensive halogen containing hydrofobizing additives, which will be reflected in low price cost of powders in comparison with imported analogues.

Raw materials: zeolite, clay shale, perlite, dolomite and ammophos are selected according to their high-performance properties and due to the factors indicating the reduction of burning processes. Such raw materials mainly are silicate origin and contain alkali and alkaline-earth metals carbonates, bicarbonates, silicates, hydroxides and crystallization water. Therefore, at their intensive heating incombustible gases, water steam and metal oxides are separated. Released incombustible gases and water steam in flame zone are functioning as phlegmatizer and in surface zone are causing the formation of swelled layer. The latter, protective film of metal oxides, swelled and coke layer create "fire-limiting" effect. This is indicating to the fact, that they are characterized by high inhibition effect [5].

The extinguishing powders not only should effectively extinguish fire, but they also should maintain their performance properties because the negative change of these properties decreases powder effectiveness. The most important performance characteristics are: tendency to consolidation and caking, moisture adsorption, powder dispersity, powder flow and storage duration. The least desirable performance property is tendency to consolidation and caking, which complicates and conclusively cancels the fire-extinguishing ability of the powder.

Materials and Methods

Fire-extinguishing powders, we prepared by mechanical treatment (milling and drying at 70-100°C) and mixing of raw materials: zeolite, perlite, clay-shale, dolomite and ammophos, which does not require the modification with expensive halogeninclusive hydrofobizing additives. On the one hand it simplifies technological process of production of powder and on the other hand decreases prices of powder.

The optimal dispersity was selected in such way, that caking capacity be minimal and a homogeneous action of combustion products on the flame as well as a heterogeneous inhibition of combustion process must take place. The evaluation of powder efficiency is carried out with consideration of the both effects.

In order to study performance properties of powders laboratory standard methods [6,7] are used - powder dispersity, moisture content and tendency to humidity, tendency to consolidation and caking, powder fluidity and storage duration. Experimental results of performance properties for promising powders are given in Table 1.

	Materials	Powder dispersity	Specific surface areas, S (cm^2/kg)	Powder fluidity, Q (kg/s)	Moisture content and tendency to humidity, W%	Tendency to consolidation and caking, C%
1	Zeolite+Clay shale +Perlite	#0.2-0.3	5100	0.14	0.02	0
2	Zeolite+Perlite+Clay shale+Dolomite	#0.2-0.3	5530	0.16	0,03	0.02
3	Zeolite+Perlite+Clay shale+Amophos	#0.2-0.3	5475	0.15	0.05	0.04

Table 1: Performance properties of powder.

In order to determine fire-extinguishing ability the polygon test methods are used, which consider extinguishing of different class standard fires with the help of fire- extinguishing constructions [8]. Polygon test methods are very inappropriate as they are quite expensive and need a great quantity of powder and fuel material to be consumed. Therefore, with consideration of standard conditions of different class standard fire development we have worked out the laboratory (experimental) method of fire extinguishing ability determination (Figure 1), which allows to determine fire-extinguishing ability of powders, when they are supplied with different intensities, or to study the dependence among extinguish time, mass consumption and supply intensity.

Description of the method

The device consists of a cylindrical combustion chamber (3). Powder is placed in spraying machine-powder atomizing vibrator with sieve (2) heated in combustion chamber. Powder spray provides variable frequency generator (1). The powder is sprayed with different intensities. Liquid fuel (benzene) is placed in combustion tank (4), ignited and placed under combustion chamber. After 90 sec (free combustion) the generator is turned on. The variation of powder supply intensity is done by variation of the power of variable frequency generator. For separate values of powder extinguish time, powder mass consumption and supply intensity are fixed. Tests have been carried out for different composition powder.

On the basis of such experimental researches it is possible to establish the conditions of effective extinguish and use of fire-extinguish material.

Conditions for effective usage: a) extinguishing material conformance-compatibility with burning material; b) extinguishing material feeding regime: minimal specific amount of material (G_{min}); feeding intensity (I) and extinguish duration (τ).

Conditions of effective extinguish: a) dependence of extinguish duration on the intensity of powder feeding τ=f(I), which will permit to calculate a specific consumption of fire- extinguishing material if necessary (G=I τ); (b) dependence of material specific consumption on supply intensity G=f(I). Extreme point of the curve corresponds to optimum conditions of extinguish.

Citation: Gurchumelia L, Tsarakhov M, Machaladze T, Tkemaladze S, Bejanov F, et al. (2018) Elaboration of New Types, Environmentally Safe Fire-Extinguishing Powders and Establish the Conditions of Extinguish Optimum and Effective Use of Such Powders. Mod Chem Appl 6: 257. doi:10.4172/2329-6798.1000257

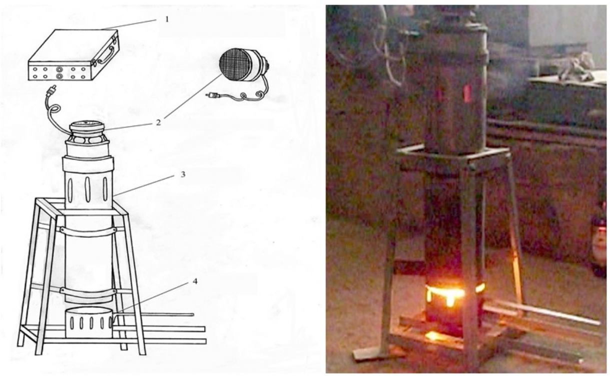

Figure 1: Installation for definition fire extinguishing ability. 1. Variable frequency generator; 2. Powder atomizing vibrator with sieve; 3. Combustion chamber; 4. Combustion tank.

With this method, we have determined the characteristics of fire-extinguishing ability: minimum mass consumption of powder (G); extinguish time (τ) and material supply intensity (I) of promising fire-extinguishing powders; studied the attachment between these characteristics and established the conditions of extinguish optimum and effective use of powders.

Experimental results of fire-extinguishing ability are given in Table 2 and Figures 2 and 3.

Results and Discussion

On the basis of experimental results it is stated, that composite fire-extinguishing powders based on of zeolites, perlites, clay shales, dolomites and ammophos are characterized by high performance characteristics as well as high fire-extinguishing capacity.

	Materials	Area of extinguishing, S, m^2	The mass of the powder spent, m, kg	Extinguish duration, τ, sec	Powder supply intensity, I, kg/m^2sec	Powder specific consumption G, kg/m^2
1	Zeolite+Clay shale+Perlite	0.07	0.15	0.8	2.6	2.14
			0.13	1.1	1.67	1.8
			0.09	2	0.65	1.3
			0.14	5	0.4	2
2	Zeolite+Clay shale+Perlite +dolomite	0.07	0.08	0.4	2.8	1.1
			0.09	0.6	2.3	1.2
			0.05	1.1	0.64	0.7
			0.12	4	0.43	1.7
3	Zeolite+Clay shale+Perlite +ammophos	0.07	0.1	0.6	2.3	1.4
			0.11	0.8	2.1	1.6
			0.08	1.3	0.9	1.14
			0.13	4.5	0.4	1.8

Table 2: Fire-extinguishing ability.

The dependence of extinguish time (τ) on powder supply intensity (I)-τ=f(I) (Figure 2) is expressed with unequal-sided hyperbola. The left wing of hyperbola shows that there is a critical value of supply intensity (I<0.3-0.5 kg/m^2sec) when extinguishing does not happen. While right wing shows that if intensity is (I<1.2-1.4 kg/m^2sec) extinguish happens instantly: or τ does not change with supply intensity increase, it retains its minimum value. But at intensity increase for supply intensity I-0.6-0.4 kg/m^2sec the extinguish time is proportionally reduced which allows to calculate powder specific consumption G=I × τ in the necessary case.

Citation: Gurchumelia L, Tsarakhov M, Machaladze T, Tkemaladze S, Bejanov F, et al. (2018) Elaboration of New Types, Environmentally Safe Fire-Extinguishing Powders and Establish the Conditions of Extinguish Optimum and Effective Use of Such Powders. Mod Chem Appl 6: 257. doi:10.4172/2329-6798.1000257

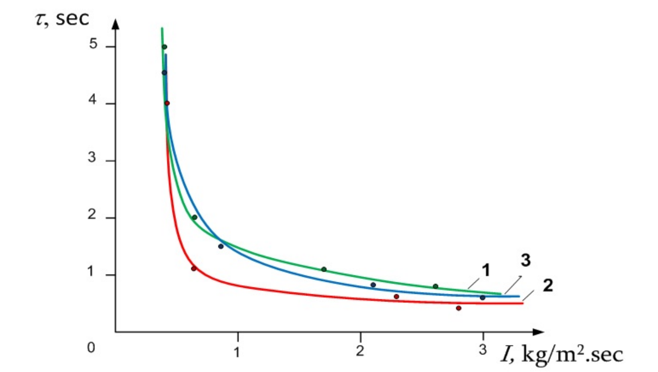

Figure 2: The relation of extinguish time on powder supply intensity.

- Zeolite+perlite+clay shale.
- Zeolite+perlite+clay shale+dolomite.
- Zeolite+perlite+clay shale+ammophos.

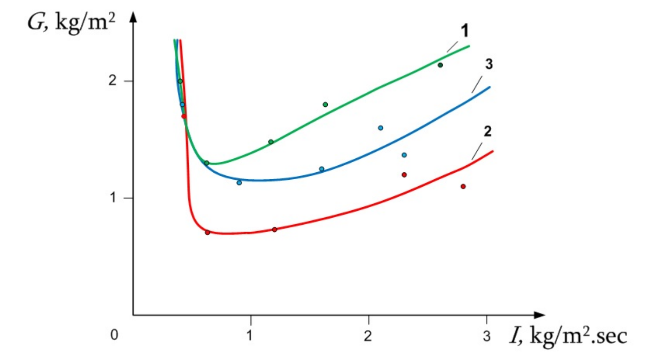

Figure 3: The relation of powder specific consumption on supply intensity.

- Zeolite+perlite+clay shale.
- Zeolite+perlite+clay shale+dolomite.
- Zeolite+perlite+clay shale+ammophos.

The relation of powder specific consumption (G) on supply intensity G=f(I) is expressed with a curve (Figure 3) the bending point (curve minimum) corresponds to optimum conditions of extinguish. It shows the value supply intensity corresponded with minimum value of powder consumption.

For promising powders optimum condition of extinguish is: powder supply intensity I-0.6-1.0 kg/m^{2}sec to fire center when powder specific consumption does not exceed G=0.8-1.2 kg/m^{2}sec.

On the basis of experimental researches, the conditions of effective extinguish and use of promising fire extinguish powders are established: powder supply intensity into seat of fire I-0.6-1.0 kg/m^{2}sec, when minimum consumption of powder G=0.8-1.2 kg/m^{2}sec provides fire- extinguishing in minimum time.

From the all above-mentioned we can suggest, that the efficiency of composite powders mineral raw materials: zeolites, perlites, clay-shales, dolomites and ammoph is not worse than standard powders of common production, but unlike them they are non-halogen, environmentally safe and inexpensive (1.2-2 times cheaper). Thus, their use is possible at extinguishing all types of fires in aboveground, as well as, underground constructions and does not need additional antiseptic measure.

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