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Forest Fires Extinguishment by Means of the Multipurpose Fire Appliance

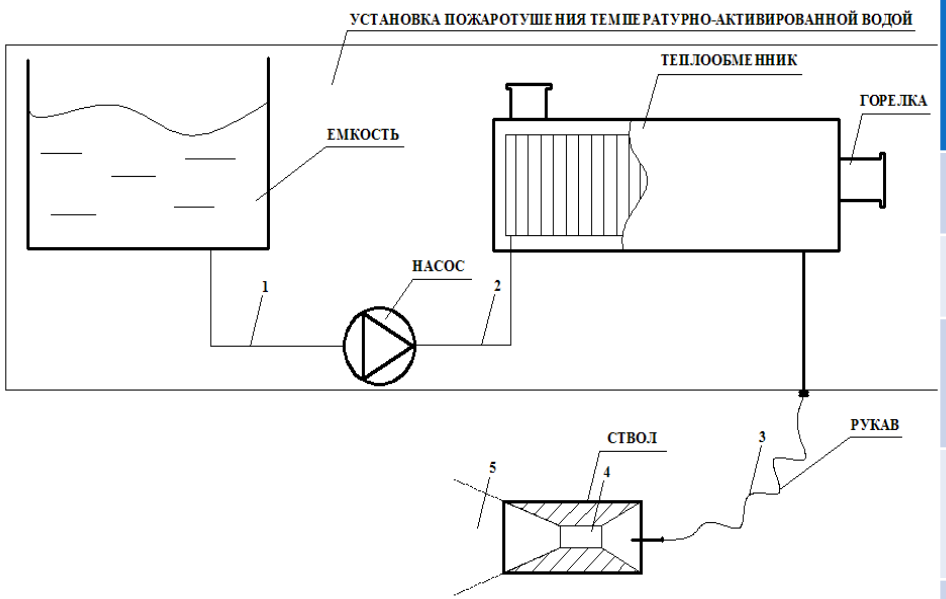
Aqueous Medium in a Metastable Phase State

Spraying Unit Multifunctional URM

- **Plastic water tanks with 3 cubic metre capacity;**
- **Electric generator (voltage/ frequency – 400 V/ 50 Hg; nominal power 100 KwT);**
- **Electrical pump installation with water pump (centrifugal high pressure fire pump) 4/400;**
- **Electrical pump installation with water pump 1.1 PT -5/10,0;**
- **Efficiency is 2 l/sec. at pressure of 40 atm. and water temperature of 165-200 degrees C ;**
- **Efficiency is 1,38 l/sec. at pressure of 100 atm. and water temperature of 165-300 degrees C.**

Installation for obtaining Water Environment in a Metastable Phase State -

is a vapour-drop mixture obtained as a result of instantaneous transition (during 10^{-4} – 10^{-9} sec) of underheated water into metastable condition with subsequent explosive boiling



№	Temperature, °C	Pressure, MPa	Condition	Time, sec.
1	4 - 60	0,01	water	1 - 3
2	4 - 60	1,6 - 4,7	water	3 - 5
3	160 - 310	1,3 - 2,0	underheated water	40 - 100
4	160 - 310	0,6 - 1,9	overheated water	10^{-4} – 10^{-9}
5	60	0,01	TAW	300 - 1800

Aqueous Medium in a Metastable Phase State composition - underheated vapour and drops with the size of 1,0 -10,0 mkm

Diameter of the majority of drops is 1,0 -5,0 mkm.

That's why TAW sprays "hang up" in air and many observers take them as vapour by mistake.

Aqueous Medium in a Metastable Phase Statesprays don't precipitate for a long time (20-40 min.),

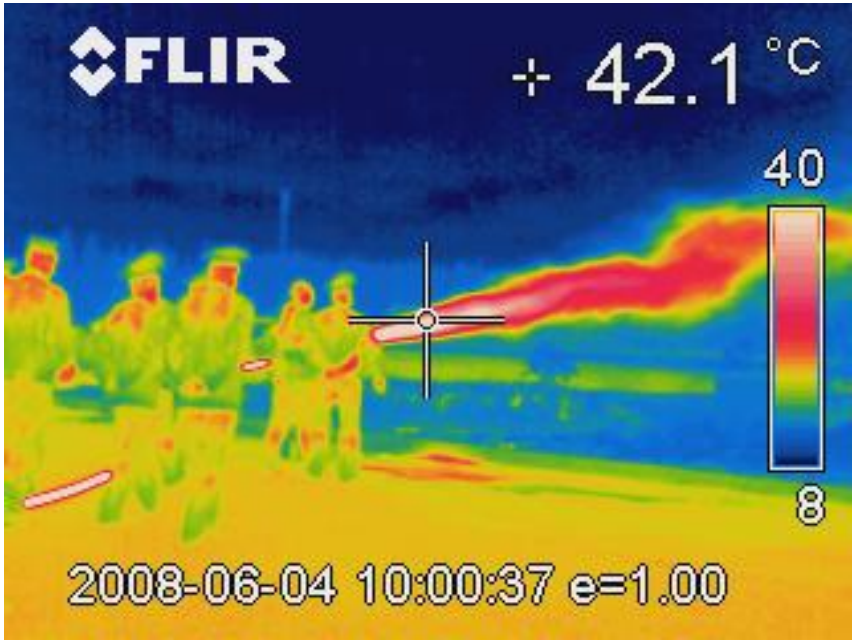
skirt all obstacles without precipitating on vertical and horizontal planes, when delivered even on horizontal surfaces they tend to go upwards

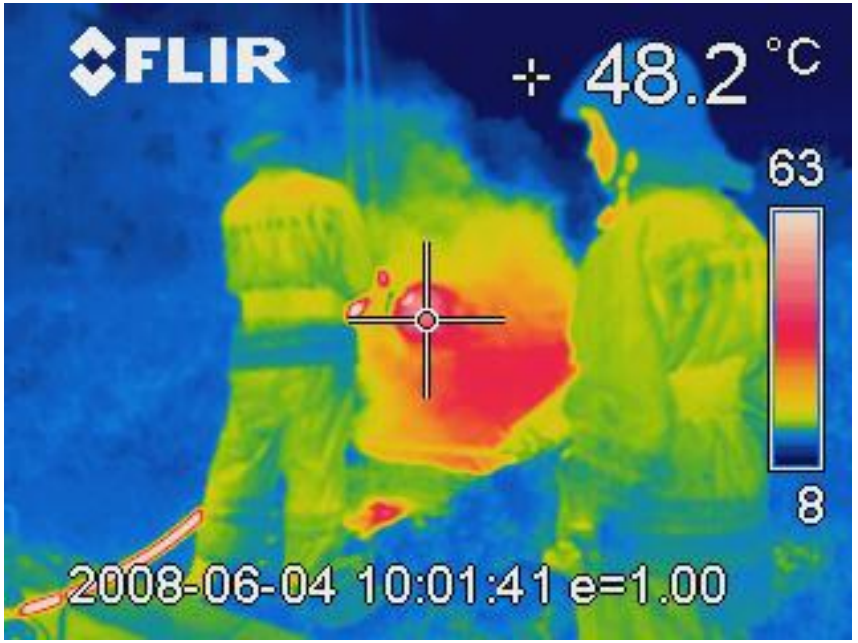
Aqueous Medium in a Metastable Phase Statecan be used for extinguishing almost all types of combustible materials that don't react chemically with water when a great amount of heat or combustible gases is evolved

Aqueous Medium in a Metastable Phase State is safe for people

Temperature of TAW is not more than 60 degrees C

Temperature of Aqueous Medium in a Metastable Phase Statespray





Aqueous Medium in a Metastable Phase Statesprays for extinguishing forest fires

Long range branchpipe

(length of spray – 8-12 metres, discharge of water – 0,7 l/sec.)

Aqueous Medium in a Metastable Phase State delivery from long range branchpipe for watering tree crowns

Aqueous Medium in a Metastable Phase Statesprays for extinguishing forest fires

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Aqueous Medium in a Metastable Phase State sprays for extinguishing forest fires

Long range branchpipe

(length of spray – 8-12 metres, discharge of water – 0,7 l/sec.)

Extinguishing class 1A model heart (wooden pile in the form of a cube) by TAW spray from a long range branchpipe with water discharge of 0,7 l/sec

Extinguishing class 1A model heart (round pan with inflammable liquid) by Aqueous Medium in a Metastable Phase State spray from a long range branchpipe with water discharge of 0,7 l/sec

sprays for extinguishing forest fires

Special MPFA branchpipe

(length of spray – 5-8 metres, discharge of water – 0,5 l/sec.)

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Aqueous Medium in a Metastable Phase State sprays for extinguishing forest fires

Special MPFA branchpipe

(Range of spray at 180 degrees, water discharge is 0,5 l/sec)

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Special MPFA branchpipe

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Full range of Aqueous Medium in a Metastable Phase State spray, gradual water temperature rise

Full range of Aqueous Medium in a Metastable Phase State

spray

stability of the process

Aqueous Medium in a Metastable Phase State sprays for extinguishing forest fires

Transformer – branchpipe

(length of spray – 2-5 metres, discharge of water – 0,35 l/sec.)

Range of Aqueous Medium in a Metastable Phase Statespray

Transformer- branchpipe is folded

Aqueous Medium in a Metastable Phase State sprays for extinguishing forest fires

Transformer- branchpipe is advanced

(length of spray – 2-5 metres, discharge of water – 0,35 l/sec.)

Aqueous Medium in a Metastable Phase Statesprays for extinguishing crawling fire

Formation of TAW cloud on the plane from transformer branchpipe and two special MPFA branchpipes

Aqueous Medium in a Metastable Phase Statesprays for extinguishing crawling fire

Formation of TAW cloud on the plane from transformer branchpipe and two special MPFA branchpipes

Aqueous Medium in a Metastable Phase State sprays for extinguishing crown fire

Formation of TAW cloud on the plane from transformer branchpipe and two special MPFA branchpipes

Aqueous Medium in a Metastable Phase State sprays for extinguishing crown fire

Formation of TAW cloud on the plane from transformer branchpipe and two special MPFA branchpipes

TAW sprays for extinguishing forest fires

Nozzle for smoke exhauster

TAW sprays for extinguishing forest fires

Nozzle for smoke exhauster

Formation of Aqueous Medium in a Metastable Phase State cloud in the tree crown by means of two nozzles for smoke exhauster, transformer- branchpipe and special MPFA branchpipe

Aqueous Medium in a Metastable Phase State sprays for extinguishing forest fires

Simultaneous branchpipe delivery

Levitating foam – Aqueous Medium in a Metastable Phase Stateobtained from foamer solution in underheated water

Levitation (from lat. Levitas " lightening") – phenomenon when an object "hangs up" in space without any visible bearing (i.e. *levitates*) without gravitation to surface

Delivery of levitating foam from long range branchpipe

The most efficient way of suppressing crown fires is early detection of crawling fire and not admitting its changing into crown fire

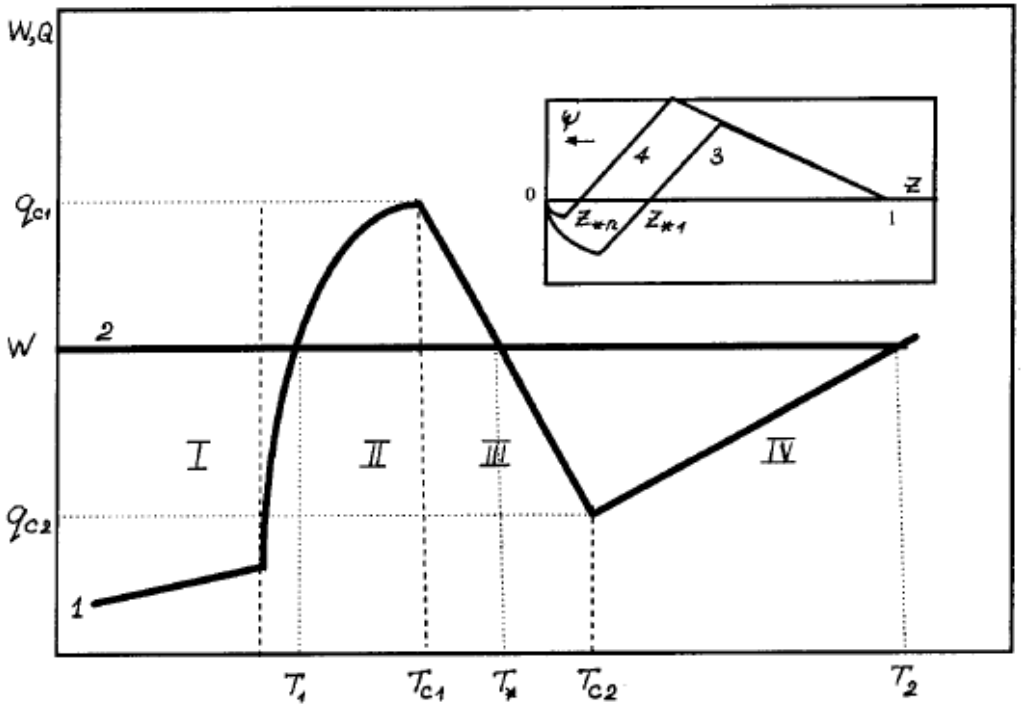
- Widespread crawling fires of long duration and in gusty weather change into crown fires.
- Crawling fires without flame (smoldering fires) happen to be the most difficult ones in terms of their detection and suppression. This type of fires can develop for a long time in dead vegetation or under tree roots forming local fire hearts with the temperature of 300-600°C and more.
- Deepseated hearts of dead vegetation or peat burning can develop further on even after their watering and blanketing with ground or sand.
- Watering and blanketing can not only hide visible signs of underground fire hearts for some time but also contribute to their development due to reducing heat transfer into the ambient air (air, ground). After 3-4 days of deepseated combustion such fire hearts can result in secondary ignition of the areas that were considered to be completely extinguished.

The amount of water necessary for suppressing crawling forest fire with dead vegetation layer of different thickness and 100% burnout

Thickness of layer, sm	Maximum amount of water necessary for absorbing energy at burnout of dead vegetation with the square of 1 m²					
	Specific gravity of dead vegetation 150 kg/m³			Specific gravity of dead vegetation 350 kg/m³		
	With water (25%) and ash (10%)	Without water, with 10% ash	Without ash and water	With water (25%) and ash (10%)	Without water, with 10% ash	Without ash and water
10	54,9	78,3	87,0	128,1	182,7	203,0
20	109,8	156,6	174,0	256,2	365,4	406,0
30	164,3	234,9	261,0	384,3	548,1	609,0
40	219,6	313,2	348,0	512,4	730,8	812,0
50	274,5	391,5	435,0	640,5	913,5	1015,0

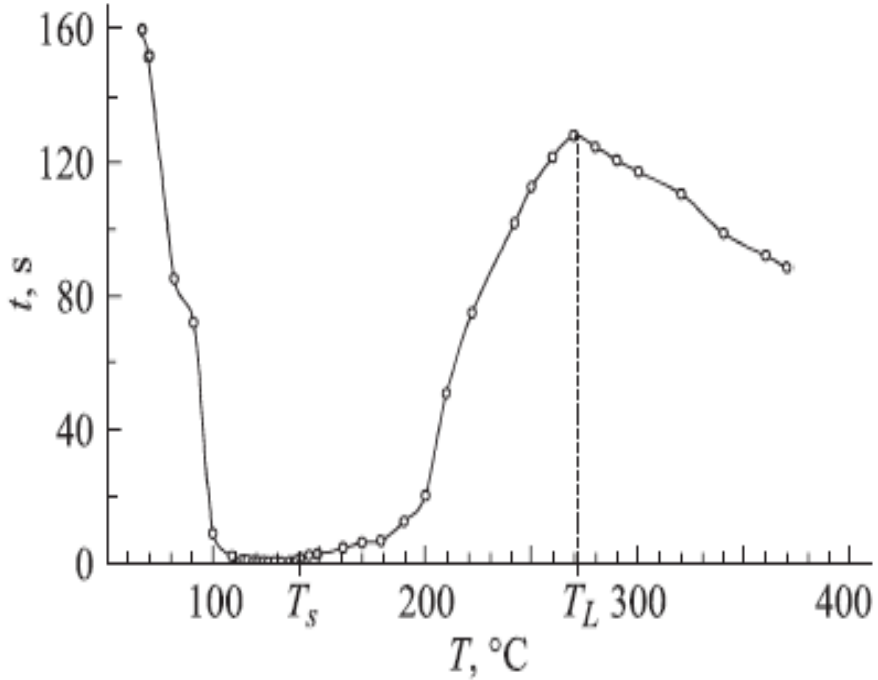
Use of thermal imaging unit

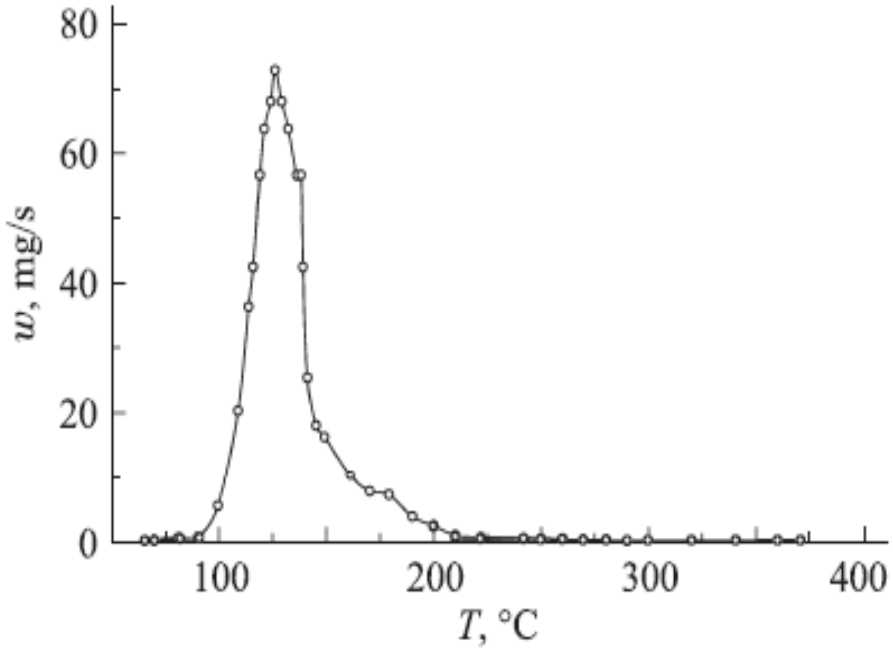
- Some parts of surface without isible residues of combustion have latent temperature regions heated up to 350-400 C, the temperature in certain places reaching 600-700 C.
- Maximum temeratures were observed either under the layer of sand which the seats of burning dead vegetation were blanketed with or under tree roots especially if the roots had been covered with sand or ground before.



Зависимость теплообмена от температуры нагревателя при установившемся режиме и функция источника для постоянного тепловыделения: *1* — Q(T), *2* — W(T). Режимы теплообмена: I — конвекция, II — пузырьковое кипение, III — переходное кипение, IV — пленочное кипение. На вставке фрагмент изменения $\psi(z)$ в предельном переходе $W \Longrightarrow q_{c1}$, *3,4* — соответствуют z_{*1}, z_{*n}; $z_{*1} > z_{*n}$.

Dependence of heat exchange on heater temperature under established regime and function of source for continuous heat evolving: Regimes of heat exchange: I – convection, II – bubble boiling, III – transient boiling, IV – film boiling. At the insertion the section of change $\Psi(z)$ in the limit transition $W \rightarrow q_{c1}$, 3,4 - correspond to Z_{*1} , Z_{*n}; $Z_{*1} > Z_{*n}$





1. **At the temperature of dead vegetation being 100-160 C water drop evapourates during 0,2-0,3 sec.**

2. **When the temperature of dead vegetation rises to more than 160 C the time of drop evapouration increases to 2-3 min.**

3. **When the temretature of dead vegetation rises to more than 270 degrees C (Leidenfrost temperature) stable vapour film is formed over the surface via which water pours down to places with temperatures of less than 160 degrees C and water doesn't take part in extinguishing high temperature fire heart**

Efficiency of wetting agent application (foam components)

- **At temperatures of dead vegetation being more than 160 degrees C the use of wetting agents can aggravate extinguishment of deepseated fire hearts**
- **Use of water jets with foam components can result in isolating deepseated fire heart**

- Добавление в воду реагентов уменьшающих интенсивность парообразования улучшает эффективность тушения скрытых очагов горения лесной подстилки !

Water boiling crises on the surface of dead vegetation or sand result in vapour layer formation which makes the rate of water evapouration 300-600 times more thus preventing water from penetrating into deepseated or burnt out to dead vegetation surface fire heart

For improving extinguishment of deepseated fire hearts in dead vegetation it is necessary:

- **To detect areas with the temperature of more than 270 °C with the help of thermovisor;**
- **To extinguish deepseated fire hearts by compulsory agitation of all the dead vegetation to all the depth of the burning layer;**
- **To compulsory control the temperature of dead vegetation after its extinguishment with the help of thermovisor**

Extinguishing peat by Aqueous Medium in a Metastable Phase State spray from long range branchpipe

Extinguishing peat by Aqueous Medium in a Metastable Phase Statespray from long range branchpipe

Result of extinguishing dead vegetation by Aqueous Medium in a Metastable Phase Statespray. Sarov, August, 2010

Result of extinguishing dead vegetation by Aqueous Medium in a Metastable Phase State spray. Sarov, August, 2010

Propositions of State OOO НПО ТЭВС of Russia in the project of joint plan activities (JPA) of APEC economies

Joint scientific work

- Research of innovation technologies effectiveness of forest fires suppression
- Working out effective ways of forest fires suppression taking into account technical and tactical capabilies of fire service units of APEC economies
- Working out techniques for forest fires suppression taking into account peculiarities of forest fires on the territories of APEC economies

Joint forest fires suppression

- Working out plans for joint forest fires suppression taking into account technical and tactical capabilies of fire service units of APEC economies
- Conducting special courses for APEC economies representatives in mastering innovation technologies of forest fires suppression

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Light is beautiful, not the fire of a fire