BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LXI No. 2/2009	65 - 68	Seria Tehnică

The Study of Liquid's Jets Used to Extinguish Petroleum Products Fires

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Abstract

This paper presents the experimental researches regarding structure and distance of foam's jet used for extinguishing petroleum products fires. The devices used for researches takes into account the real burning processes and the phenomena from the area of burning of such products, so real equipment and fire accessories are used in order to have accurate results, which can be applied to real fire interventions.

Key words: *foam concentrate, jet's structure, jet's distance*

Introduction

Because of the fact that in case of petroleum products fires, temperatures in the fireplace areas are very high, it has resulted the need to improve conditions of formation of liquid jets used to extinguish such fires and implicitly obtaining longer distances from which firefighters can act in safety.

Fire-fighting foam is a collection of air-filled bubbles being made up of three ingredients: water, foam concentrate and air. Fire-fighting foams are resistant to fire, the most of them containing chemicals like Fluorine, which prevent combustion. The foam principle formation is a simple one and consists of mixing water with a foam concentrate, which is proportioned, to form a foam solution. Foam is aerated by forcing foam solution through foam making equipment (fig.1). The foam must flow freely over the burning liquid surface in order to form a tough, air-excluding blanket that separates volatile combustible vapors from access to air (fig. 2) [4, 5].

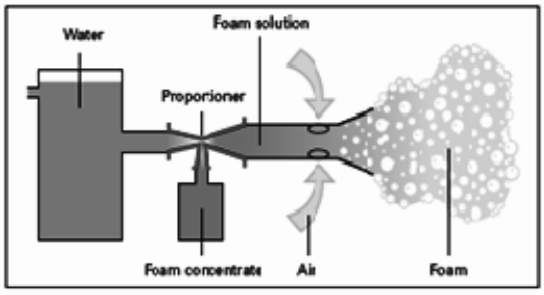

Fig. 1. Formation of fire-fighting foam

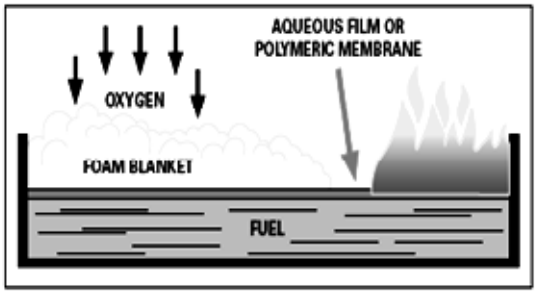

Fig. 2. Work principle of fire-fighting foam

Length and Structure of Foam's Jet Used for Extinguishing Petroleum Products Fires

To determine the fluid jets distances used to extinguish oil fires, it were realized devices similar those used in real fire interventions, which consist of a fire truck APCA 12 215 equipped with a centrifugal pump type PSI 50 / 8, a line of hose type "B", diameter Ø = 76 mm, and foam-generating pipe of 5000 l / min, respectively FJM- 80 monitor (fig. 3,4).

With such equipment was determined the distance covered by jet of the extinguisher agent at different pressures of work and different rakes of the foam-generating pipe and the component foam nozzle of the monitor FJM-80 (fig. 5).

Fig. 3. Device used for the experimental determinations

Fig. 4. The FJM-80 monitor

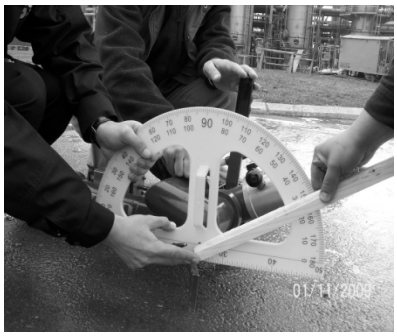

Fig. 5. Rake's adjustment

The pressure is generated by a centrifugal pump type PSI 50 / 8 (fig. 6) with the following functional characteristics:

- water capacity - up to 5 000 1/min;
- pumping height corresponding nominal flow - 80 mCA (meters column water) - 8 Pa;
- corresponding flow pumping height is 160 mCA (meters column water)–1.6 Pa - 1500 1/min.

The characteristics above-mentioned are obtained through variation in speed between 2200 – 2900 rot/min.

The results of experimental tests where the distances covered by jets were measured dependent on pressure and nozzle's rake are presented in table 1.

Table 1. Experimental results function on pressure and nozzle's rake

Device	Fluid	Rake	Presure [Pa]	Jet length [m]
Fire truck A.P.C.A. equipped with a centrifugal pump type PSI 50 / 8, a line of hose type "B", diameter Ø = 76 mm, and foam-generating pipe of 5000 l / min	water	30°	0.5	33
			1	45,5
		45°	0.5	25
			1	35
	water + foam concentrate – Filfoam 916	30°	0.5	30
			1	37
		45°	0.5	22
			1	32,5
Fire truck A.P.C.A. equipped with a centrifugal pump type PSI 50 / 8, a line of hose type "B", diameter Ø = 76 mm, and FJM- 80 monitor	water	30°	0.5	46
			1	51
		45°	0.5	33
			1	38
	water + foam concentrate - Filfoam 916	30°	0.5	43
			0	48
		45°	0.5	36
			1	42

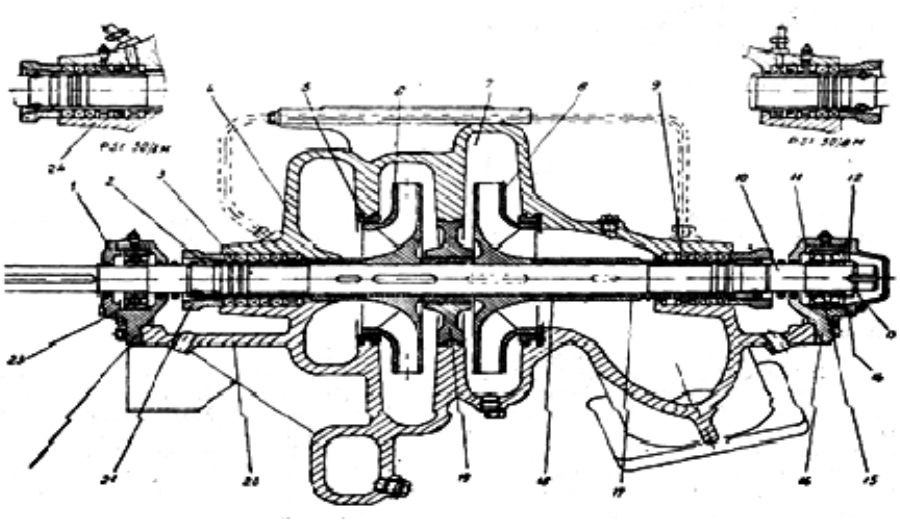

Fig. 6. Centrifugal pump type PSI 50 / 8
1 - cowl bearing, *2* - nut, *3* – joint, *4* - the upper half, *5* - labyrinth ring, *6* - left rotor, *7* – distance spout, *8* - right rotor, *9* – input ring, *10* – axle, *11* - distance ring; *12* – limitation spout, *13* - cowl bearing, *14* - bearing 3308, *15* - body right bearing, *16* – stopping semi-ring, *17* – protection spout, *18* - distance spout, *19* - diaphragm, *20* - semi-lower case, *21* - semi-joint, *22* - body left bearing, *23* - bearing 6308, *24* - rotary socket.

The liquid jets in air used in extinguishing fire interventions have three characteristic areas (fig. 8, 9), these having to be considered during extinguishing process, when the foam blanket flows over the burning liquid surface:

1. compact area;
2. decomposition area;
3. sprinkle area.

Fig. 8. Jet's structure at a 5000 l/min foam

Fig. 9. Jet's structure at a FJM-80 pipe monitor

Conclusions

This paper presents several experimental determinations of the distance covered by jet of the extinguisher agent at different pressures of work and different rakes of the foam-generating pipe and the component foam nozzle of the monitor FJM-80.

The main factors which have influence on jet length are the following:

- environment's thickness: thicker surroundings will cause an easier detachment of the jet drops and the breaking of water drops in smaller fragments;
- gravity: under gravitation's action jet heads toward Earth, the relative share of gravity being lower in a compact area of liquid jet in air than in other areas;
- launch angle from horizontal: although theoretically ideal launch angle is 45 ° from the horizontal, due multiples factors involved, it is around 30 ° (± 2°) for reaching higher values as the distance of horizontal and vertical, but in practice there is a fairly wide range of values (0 ° to 80 °) which can be used in interventions;
- characteristics of launch nozzle: form, length, angle of convergence, diameter and pressure influence the fundamental characteristics of jet;
- natural wind: breaking jet into drops occurs faster when the wind blows from the side towards the jet trajectory and contrary to the nozzle of the jet launch; during our performance tests, wind was very calm, estimated maximum speed of 0.5 m / s this situation being favorable for precise results.
- jet's continuity: it was noticed that if it is applied inclined oscillator motions to nozzle foam's discharge, the jet's length will be diminished.
- physico-chemical properties: these properties of water and the other extinguisher agents - especially density and viscosity - are important for jet's dynamic, the results could be seen in table 1.

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Studiul jeturilor de lichide folosite la stingerea incendiilor de produse petroliere

Rezumat

Articolul de față prezintă cercetările experimentale privind structura şi distanța parcursă de jetul de spumă folosită pentru stingerea incendiilor de produse petroliere. Pe timpul efectuării cercetărilor se ține cont de condițiile reale ale proceselor de ardere şi de fenomenele existente în zona în care ard astfel de produse, aşa că pentru obținerea unor rezultate precise, care să poată fi folosite în practică, echipamentele şi accesoriile utilizate sunt dintre cele folosite la intervențiile reale de stingere a incendiilor.