THERMOPHYSICAL CHARACTERISTICS OF FUSION THERMAL TRACERS

L. N. Novichenok, I. L. Svirnovskaya,
and S. M. Kazakova

UDC 536.2.083

The results of an investigation into the thermophysical characteristics of fusion thermal tracers used for determining the temperature fields of heated surfaces are presented.

The thermal-tracer method of measuring temperatures is comparatively new, but it is already being effectively used in practical scientific and technological investigations [1-4]. The method is based on changes in the light, phase state, or luminescent intensity of special paint coatings. Using such thermal tracers, changes in the surface temperature of heated solids may be rapidly and fairly accurately monitored, especially in cases in which other measuring methods are unsuitable.

Thermal-tracer coatings belong to the class of contact temperature sensors, for which errors tend to arise as a result of thermal inertia and the distorting influence of the heat-sensitive paint on the temperature field of the test object. In order to estimate this error we must know the thermal conductivity and thermal diffusivity of the thermal sensor.

TABLE 1. Thermophysical Characteristics of Fusion Thermal Tracers

Heat-sensitive point	T_{cr}, °C	λ, W/m·deg	$a\cdot10^7$, m²/sec	$c\gamma\cdot10^{-6}$, J/m³·deg	Heat-sensitive point	T_{cr}, °C	λ, W/m·deg	$a\cdot10^7$, W/m	$c\gamma\cdot10^{-6}$, m²/sec
TP-52	52	0,10	0,72	1,39	TP-123a	123	0,14	0,59	2,37
TP-60	60	0,10	0,68	1,47	TP-123b	123	0,10	0,53	1,89
TP-60a	60	0,096	0,39	2,46	TP-126	126	0,17	1,10	1,55
TP-60b	60	0,11	0,70	1,58	TP-130	130	0,16	0,96	1,67
TP-67	67	0,13	0,66	1,97	TP-134	134	0,17	1,20	1,42
TP-77	77	0,13	0,72	1,81	TP-136	136	0,12	0,56	2,14
TP-79	79	0,20	1,40	1,43	TP-144	144	0,27	1,40	1,93
TP-86	86	0,15	1,10	1,36	TP-148	148	0.20	1,20	1,67
TP-90	90	0,16	1,50	1,07	TP-150	150	0,15	1,00	1,50
TP-94	94	0,12	0,63	1,91	TP-155	155	0,12	0,63	1,90
TP-95	95	0,15	1,00	1,50	TP-160	160	0,16	0,97	1,65
TP-97	97	0,11	0,74	1,49	TP-167	167	0,29	2,00	1,45
TP-102	102	0,15	1,10	1,36	TP-172	172	0,13	0,58	2,24
TP-106	106	0,14	0,80	1,75	TP-179	179	0,14	0,68	2,06
TP-107a	107	0,10	0,46	2,17	TP-182	182	0,12	0,44	2,73
TP-107b	107	0,098	0,40	2,45	TP-193	193	0,14	0,67	2,09
TP-109	109	0,095	0,36	2,64	TP-195	195	0,15	0,60	2,50
TP-116	116	0,098	0,38	2,58	TP-212	212	0,10	0,43	2,33
TP-122a	122	0,15	0,64	2,34	TP-223	223	0,34	2,60	1,31
TP-122b	122	0,14	0,64	2,19	TP-254	254	0,14	0,92	1,52

Institute of Heat and Mass Transfer, Academy of Sciences of the Belorussian SSR, Minsk. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 27, No. 5, pp. 802-803, November, 1974. Original article submitted January 31, 1974.

In view of the fact that the properties of thermal-tracer paints have been little studied, while their applications are widening, a study of the thermophysical characteristics of fusion thermal tracers is extremely timely and desirable.

In order to fulfill this need we used the transient method of [5], which enabled us, in the course of a single brief experiment, to determine all the thermophysical characteristics of a thin thermal-tracer coating.

The tests were carried out at 20°C, and the results are presented in Table 1. The quantity T_{cr} signifies the temperature at which the color of the fusion thermal tracer changes from one to another. We see from the table that the thermal conductivity of fusion thermal tracers in the critical temperature range 50-254°C is lower than that of other thermal tracers [6]. This may be explained by the fact that fusion-type thermal-tracer paints form porous coatings.

In measuring the temperatures of heated insulator surfaces, thermal-tracer paints introduce a slight distortion into the temperature field by comparison with metal surfaces, owing to the different thermophysical properties. The measuring error is no greater than ±2°C.

LITERATURE CITED

1. B. G. Abramovich, Thermal Tracers and Their Application [in Russian], Énergiya, Moscow (1972).
2. L. N. Novichenok and S. M. Ovchinnikova, in: Heat and Mass Transfer, Vol. 7 [in Russian], Minsk (1972).
3. L. N. Novichenok, Progress in Heat and Mass Transfer, Vol. 5, Pergamon Press, Oxford and New York (1972).
4. R. A. Jones and J. L. Hant, AIAA Journal, 2, No. 7, 1354-1356 (1964).
5. L. N. Novichenok, Inzh.-Fiz. Zh., No. 9 (1963).
6. B. G. Abramovich and L. N. Novichenok, in: Heat and Mass Transfer, Vol. 7 [in Russian], Nauka i Tekhnika, Minsk (1968).