



КАЗАНСКИЙ (ПРИВОЛЖСКИЙ) ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ

Methods to identify the solid organic component in the cores

Kazan, December 2015



Solid-state components in oil

Features of physical and chemical properties of oil correlate to high content (to 20%) in them asphaltene (heavy oil) and paraffin (paraffinic oil). Asphaltene and paraffin are characterized by ability to the supramolecular organization.

Loss of paraffin from solution negatively affects when developing oil fields. Pitches, asphaltene, oils and other components of oil are besieged on the formed crystals of paraffin. The sizes of such conglomerates become commensurable with sizes of a collector pores (3-10 microns and more). In this case the permeability of productive layer and the filtration sharply decrease.

In natural bitumens the content of solid-state educations can reach 50%.

The task of the operational analysis of structure heavy and paraffinic oil by definition of quantity of asphaltene and paraffin is still actual.



The component composition of oil

Oils - liquid mixes of the high-boiling hydrocarbons, mainly the alkyl naphthenic and alkyl aromatic);

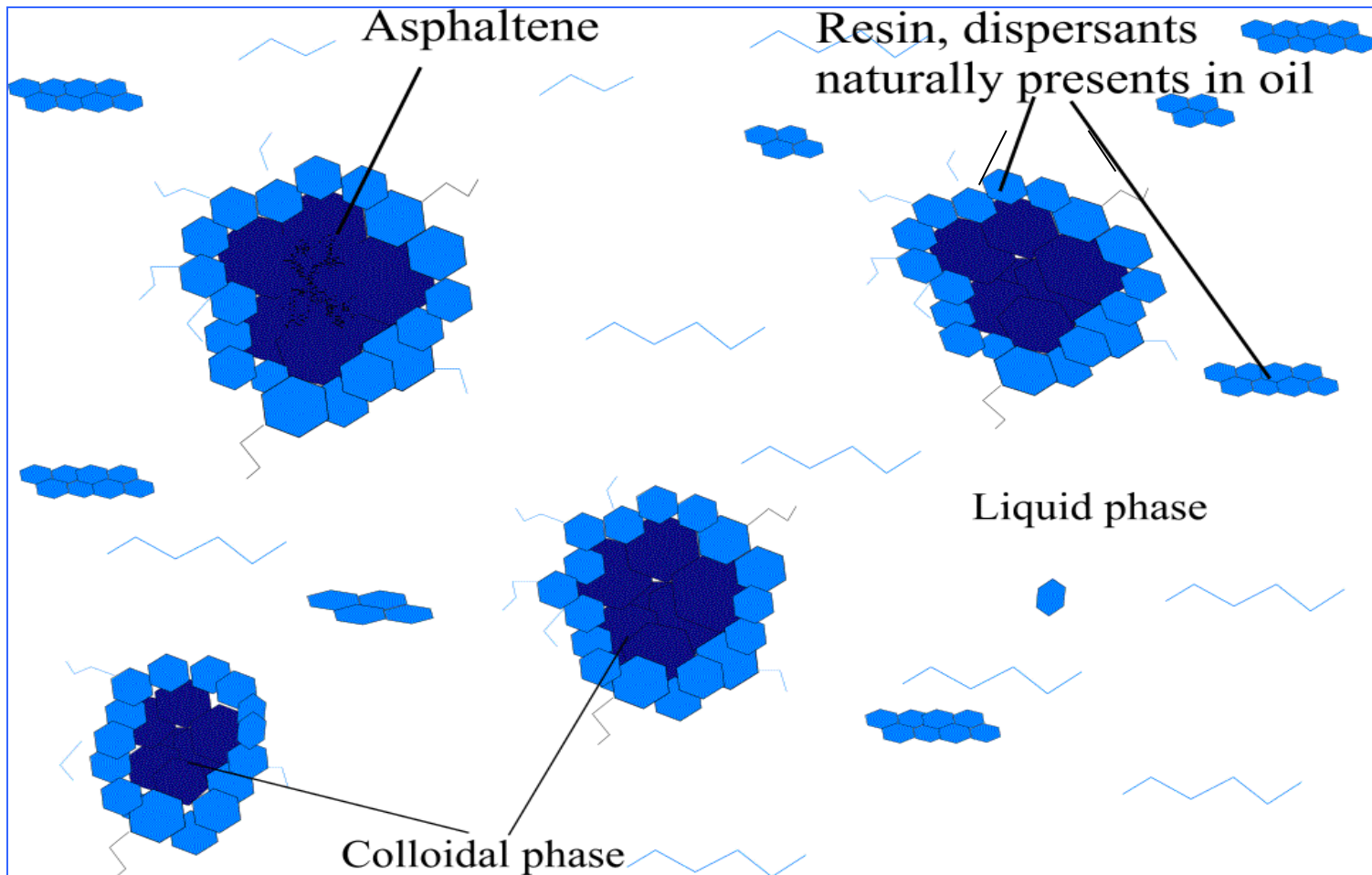
Paraffin - saturated hydrocarbons (from $C_{18}H_{38}$ to $C_{35}H_{72}$) with a quantity of hydrocarbons with an aromatic or naphthenic kernel)

Oil pitches - high-molecular heteroatomic components of oil, the average numerical molecular weight is 400-1500.

Asfaltena - the most high-molecular components of oil, the average numerical molecular weight is 1000 — 5000).



The structure of "crude" oil





Analysis methods on the basis of NMR

Authors: I.V. Nikolin, **N.V. Shkalikov**, V.D. Skirda

Method of definition of the contents liquid-phase and solid-state a component in mix of hydrocarbons

- The method is based on temperature scanning from + 5°C to +150°C a sample of oils sustained at a low temperature (not above -20°C).
- The content of a solid-state component P_s and liquid-state component P_l is controlled by a shape of a 'solid-echo' signal of a nuclear magnetic resonance.
- A shape of a 'solid-echo' signal is registered from microsecond to millisecond range by RF sequence $90^\circ_x - \tau - 90^\circ_y - \tau - Aq$.
- Information on shares of a_i of the contents solid-state components with a characteristic temperature of melting of T_i is taken from dependence $P_s(T)$ by means of fitting methods.
- Parts of a solid-state component of paraffin and asfalten calculate on characteristic temperatures of melting T_i .

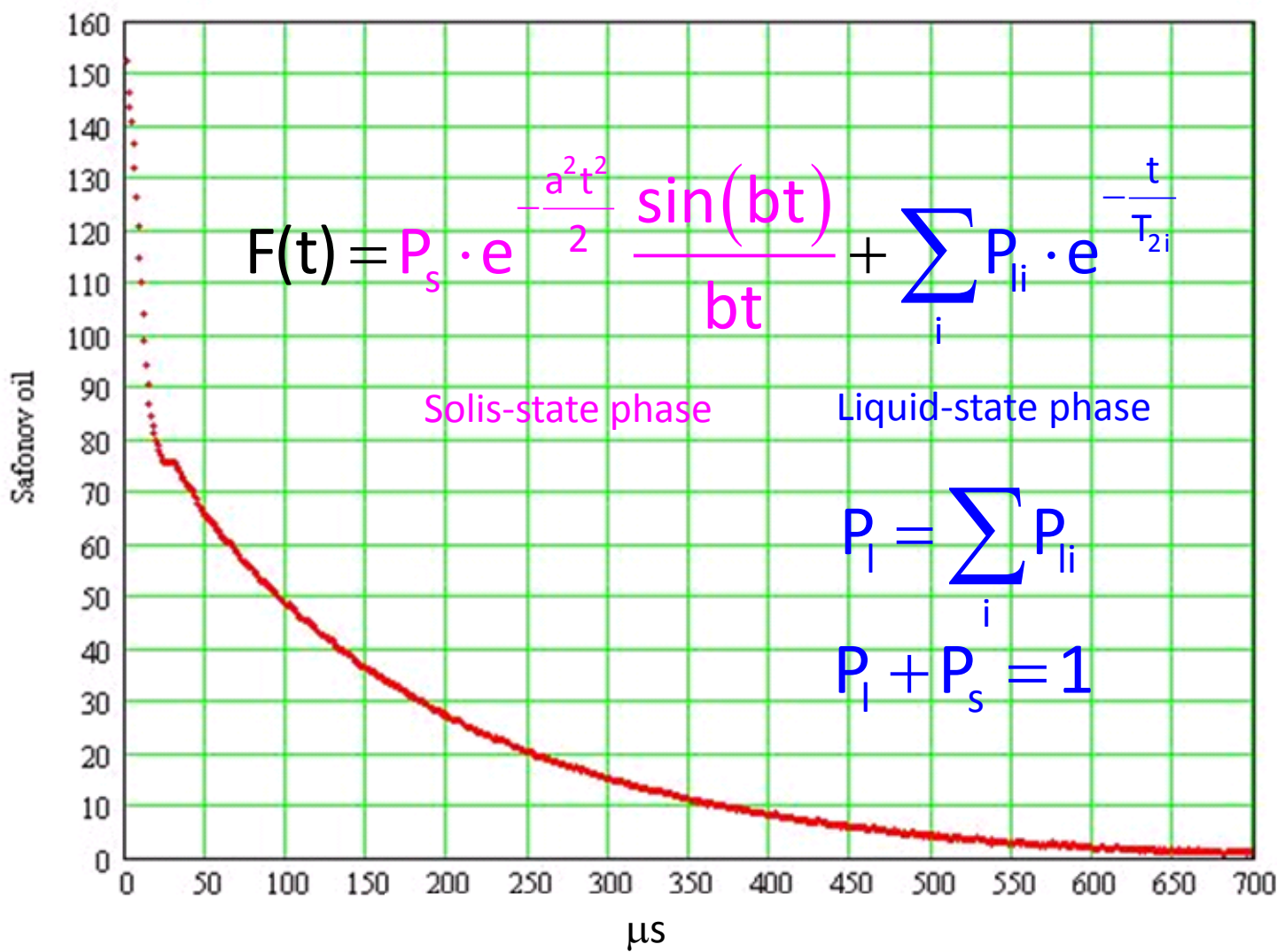


The patents

- 1. Pat. US 2010/0085047 A1 United States, Int. Cl. G01R 33/44 (200601), US. Cl. 324/307. Method for detecting paraffin wax and asphaltene content in oil [Text] / I.V. Nikolin Moscow (RU); S.S. Safonov MOSCOW (RU); V. D. Skirda, Kazan (RU), N.V. Shkalikov Kazan (RU) Assignee Schlumberger Technology Corporation (US) – Appl. No. 12/493,56, Filed Jun. 29, 2009; Pub. Data Apr. 8, 2010 – 4 p.**
- 2. Pat. US 2010/0156409 A1 United States, Int. Cl. G01 V 3/14 (2006.01), U.S. Cl. 324/303. Method for determining the content of liquid and solid phase components in hydrocarbon mixture [Text] / I.V. Nikolin Moscow (RU); N.V. Shkalikov Kazan (RU); V.D. Skirda Kazan (RU) Assignee Schlumberger Technology Corporation (US) – Appl. No. 12/636,978, Filed Dec, 14, 2009; Pub. Data Jun. 24, 2010 – 12 p.**

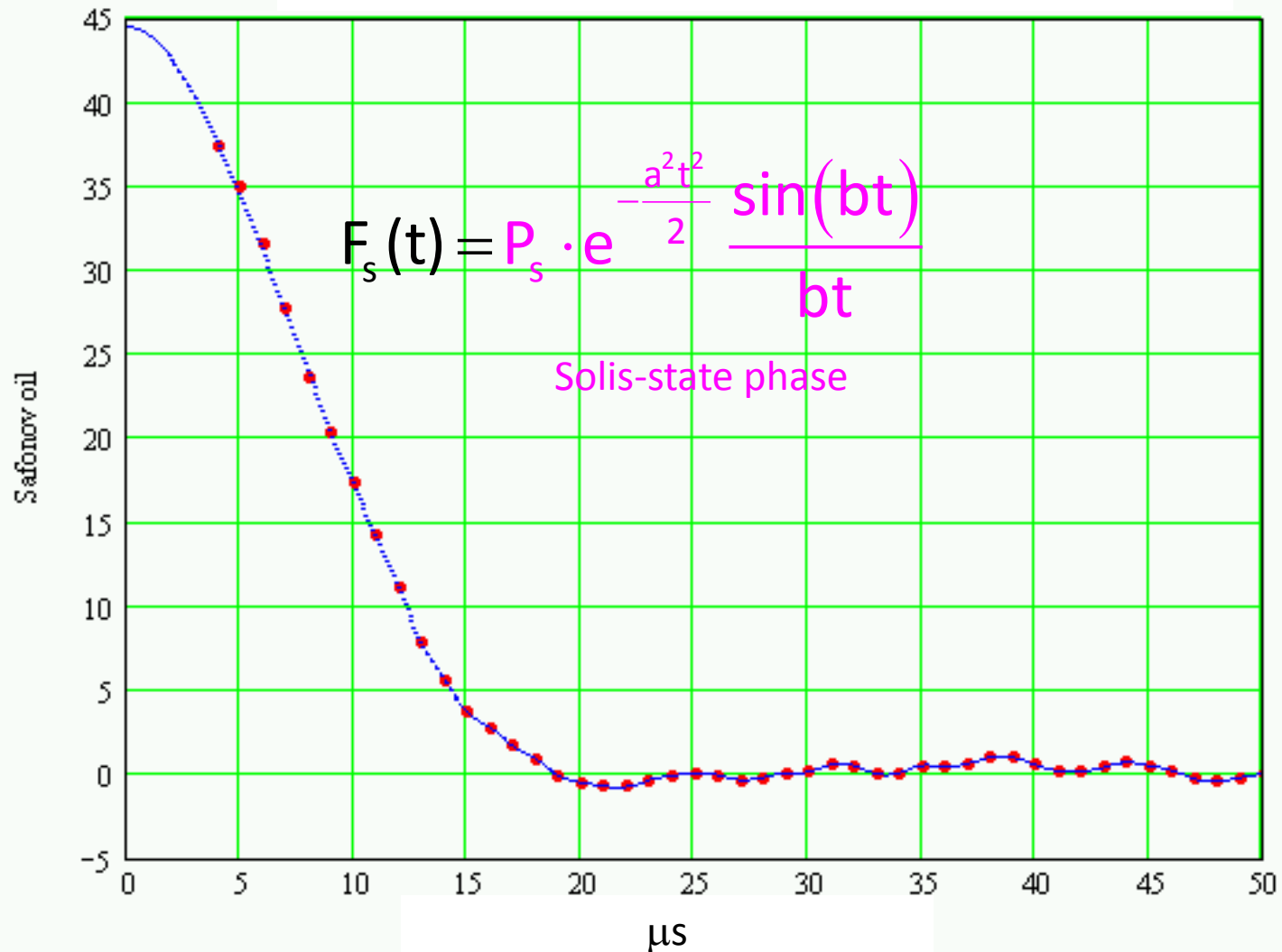


The NMR signal “solid-echo” in oil



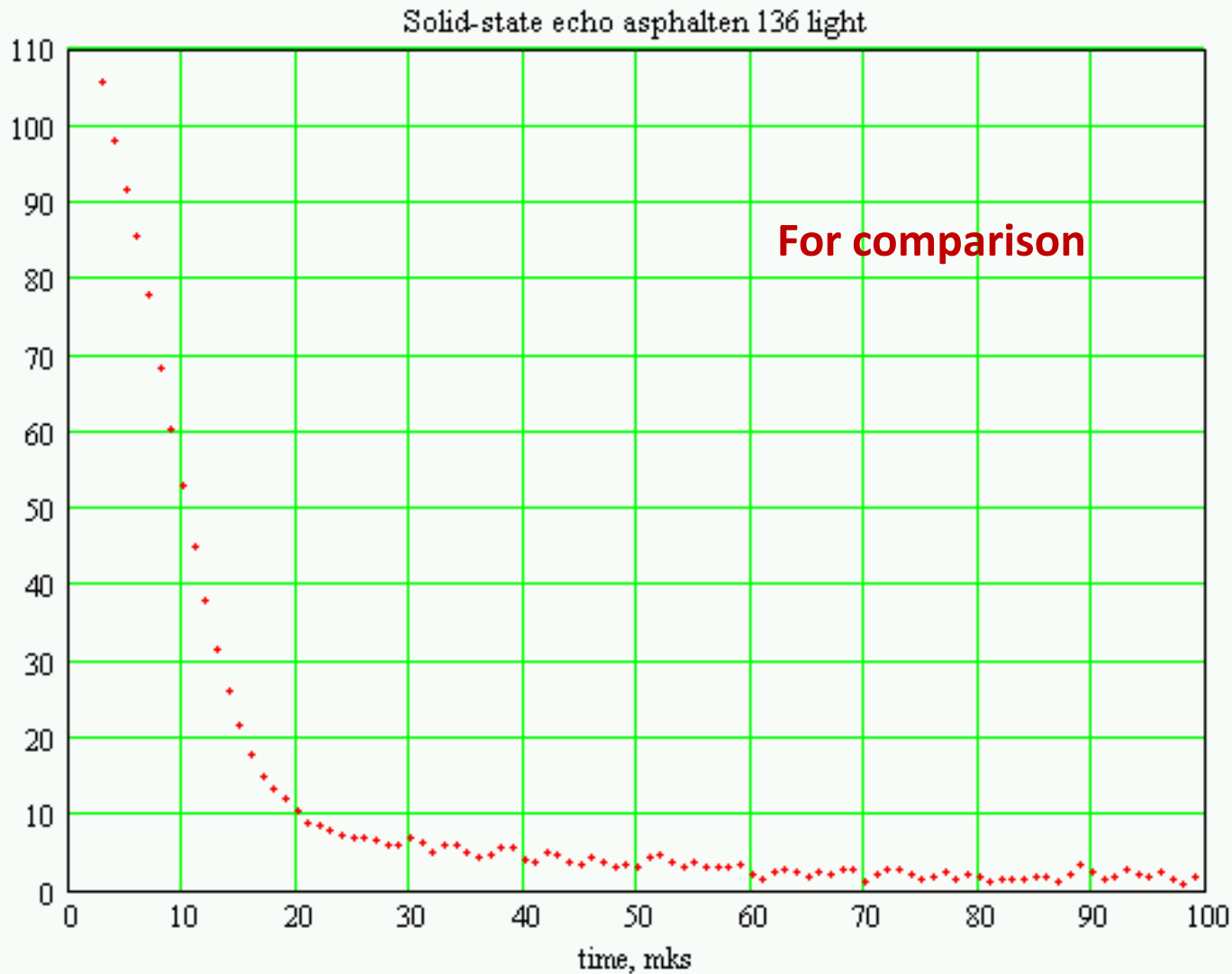


The allocated signal from solid-state phase in oil



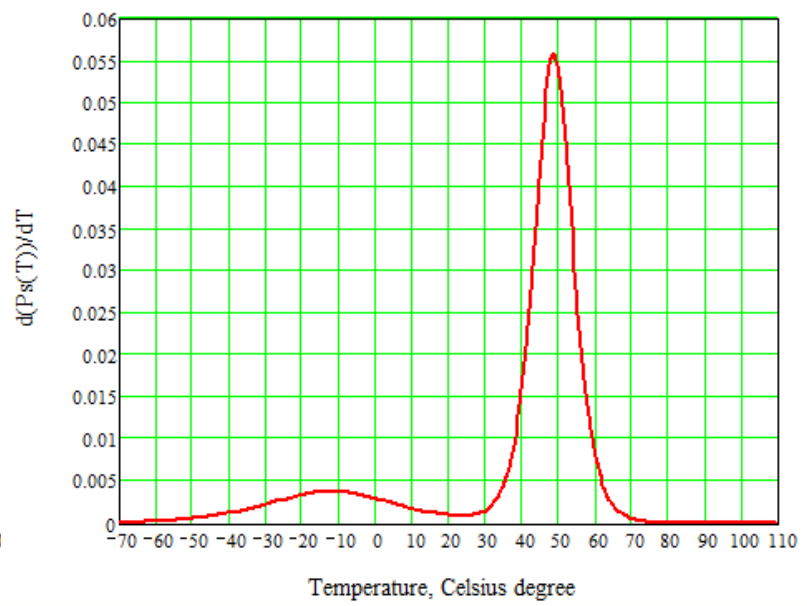
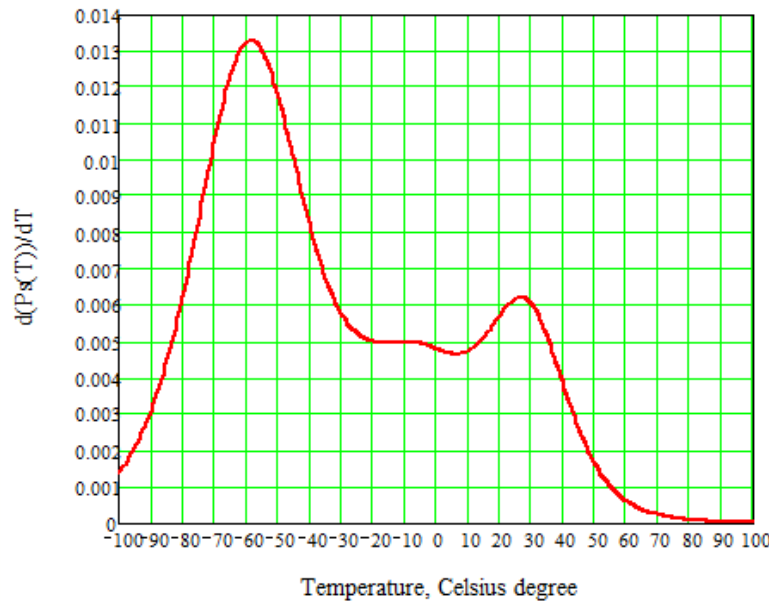
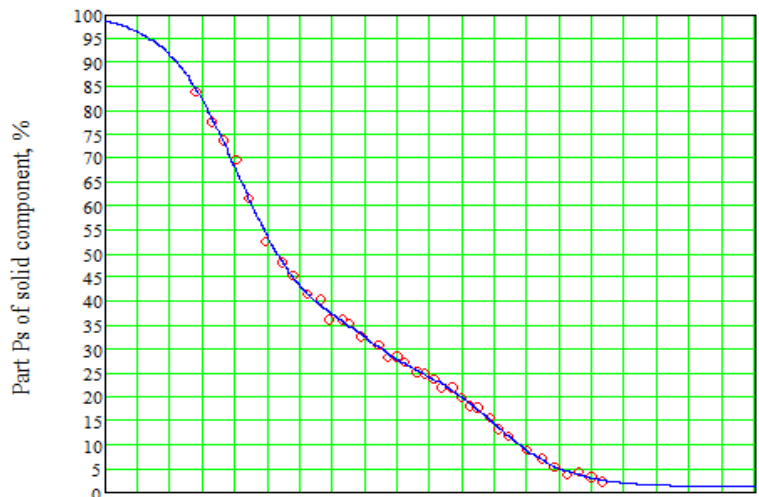
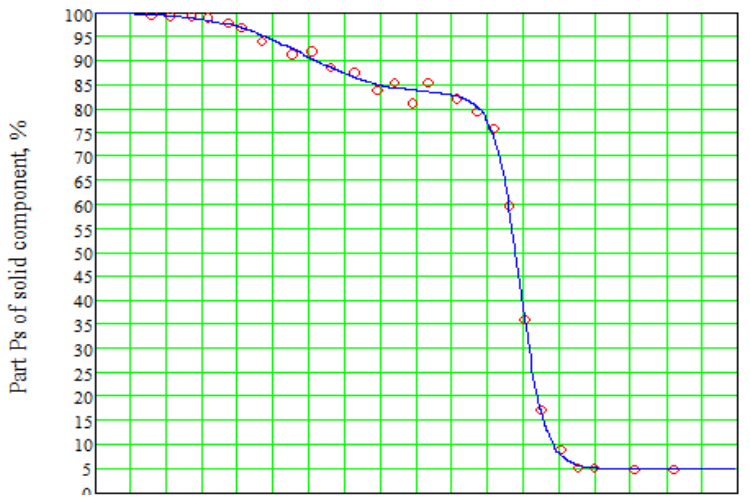


The NMR signal of “solid-echo” in a asphaltene





$P_s(T)$ for oils and for paraffin as a part of oil





**Thank you
for your attention!**

