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ANALYSES OF SOUND ISOLATING ATTRIBUTES FOR RECYCLING MATERIALS

SUMMARY

All acoustical materials and structures perform better at some frequencies than others. For this reason, a frequency analysis of the noise to be controlled is almost always required for reduction occupational or environmental noise. Recycled rubber structures made from road tyre and car seat can absorb noise thanks porous structure. For mapping needed acoustical descriptors we designed apparatus for measuring the acoustical absorption (α_n), acoustical reflection (R_o), acoustical transmitted (R_p) and acoustical isolation (D_{nf}) coefficients for normally incident sound which define acoustical materials at once. Realized prototype of apparatus based on the impedance tube and standard featuring of a sound level meter was registered as Industry Design No 3679 from 9.10.2003 by Bureau of Slovakia Industrial Property. This paper deal of frequencies analysis basic occupational acoustic characteristics of recycled porous rubber structures.

Keywords*: methodology of measuring acoustical materials, noise absorption, noise reflection, amount of noise isolation*

ANALIZA IZOLACYJNOŚCI MATERIAŁÓW WTÓRNIE PRZETWORZONYCH

Wszystkie materiały i struktury akustyczne charakteryzują się bardzo dobrymi właściwościami tylko dla pewnych częstotliwości. Z tego powodu niezbędna jest analiza częstotliwościowa hałasu generowanego przez maszyny lub otoczenie. Struktury wykonane z wtórnie przetworzonych opon i siedzeń samochodowych mogą pochłaniać hałas dzięki porowatej strukturze. Do odwzorowania potrzebnych wskaźników akustycznych zaprojektowano stanowisko do pomiaru współczynników chłonności akustycznej (α_n), odbicia (R_o), przenikalności (R_p) i izolacyjności akustycznej (D_{nf}) dla dźwięku padającego prostopadle, który natychmiast pozwala określić właściwości akustyczne badanych materiałów. Zrealizowany prototyp stanowiska pomiarowego wykorzystuje rurę oporową i typowy przyrząd pomiaru natężenia dźwięku o oznaczeniu przemysłowym No 3679 wyprodukowany 9.10.2003 przez słowacką firmę Bureau. Artykuł prezentuje analizy częstotliwościowe podstawowych przemysłowych charakterystyk akustycznych struktur porowatych wykonanych z materiałów wtórnie przetworzonych.

Słowa kluczowe*: metodologia pomiaru materiałów akustycznych, chłonność hałasu, współczynnik odbicia, izolacyjność akustyczna*

1. INTRODUCTION

After consumption of utilities accounts there are bald pneumatics go to waste. A few years ago this waste can go on scrap-heap or to burning. In this time dominates separation and recycling because such material introduce strategic second raw material. Idea of using recycled rubber structures made from road tyres and car seats ensued on our department with authorised measuring occupational noise in thermal electric power factories [3, 10, 11].

2. CHARACTERISTIC OF NOISE ABSORBING MATERIAL BASED ON RECYCLED RUBBER

Sandwich sign as RF (see Fig. 1) feeded by VÚSAPL Nitra are usually made from two or three recycled rubber deposits – recycled pneumatics, recycled lenient parts from car seats. Producer uses rubber fraction and crushed textile cord produced from PA-6 type CHEMLON. Waste from auto sheet contains PUR foam fold of textile made from PES or PVC leatherette.

Base construction such sandwich consists of:

- external fold from recycled rubber brash (diameter about 5 mm),
- internal fold from textile cord mixed with auto sheet waste (15–30%).

Producer uses capacity bulk 10–15% of butadien-polyuretan as binding material. Sandwich is made by pressing with pressure 2 MPa and temperature of die 90°C. Time of pressure is 12–13 minutes.

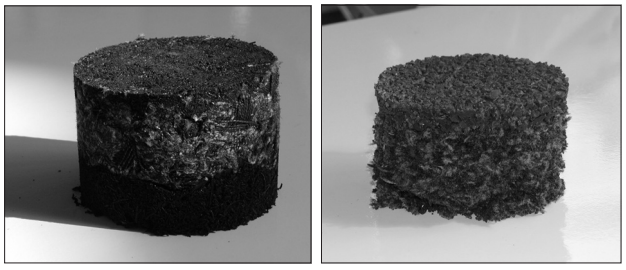

Fig. 1. Patterns of recycled rubber sandwiches

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3. METHOD OF ACCOUSTIC DESCRIPTORS MEASURING

All acoustical materials and structures perform better at some frequencies than others. For this reason, a frequency analysis of the noise to be controlled is almost always required. The measuring of occupational noise in thermal electric power factories demands controlling of noise exposure lower frequencies from 50 Hz to 2 kHz [3, 11]. Solving of this problem calls for study adequate acoustics materials. Many producers are oriented for controlling absorption characteristic only. Our experiences illustrate on necessary of complex research occupational acoustic descriptors. Measuring of these descriptors is the basic method for acquirement of real acoustic values.

Measurement of the absorption characteristic of acoustical materials can be accomplished with normally incident, or randomly incident, sound waves [2, 4, 8]. Although random incidence more nearly approximates conditions of actual use, measurements at normal incidence are much easier to obtain and are valuable for rank-ordering of acoustical absorbing materials and structures.

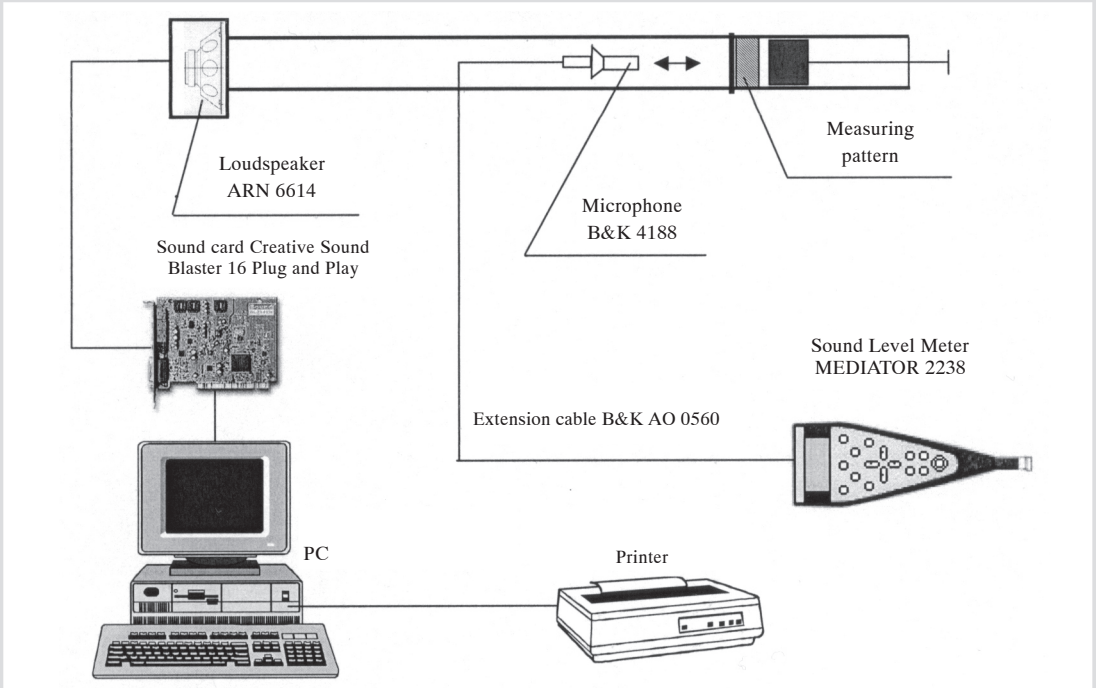

Fig. 2. Diagram of absorption and reflection coefficient measuring

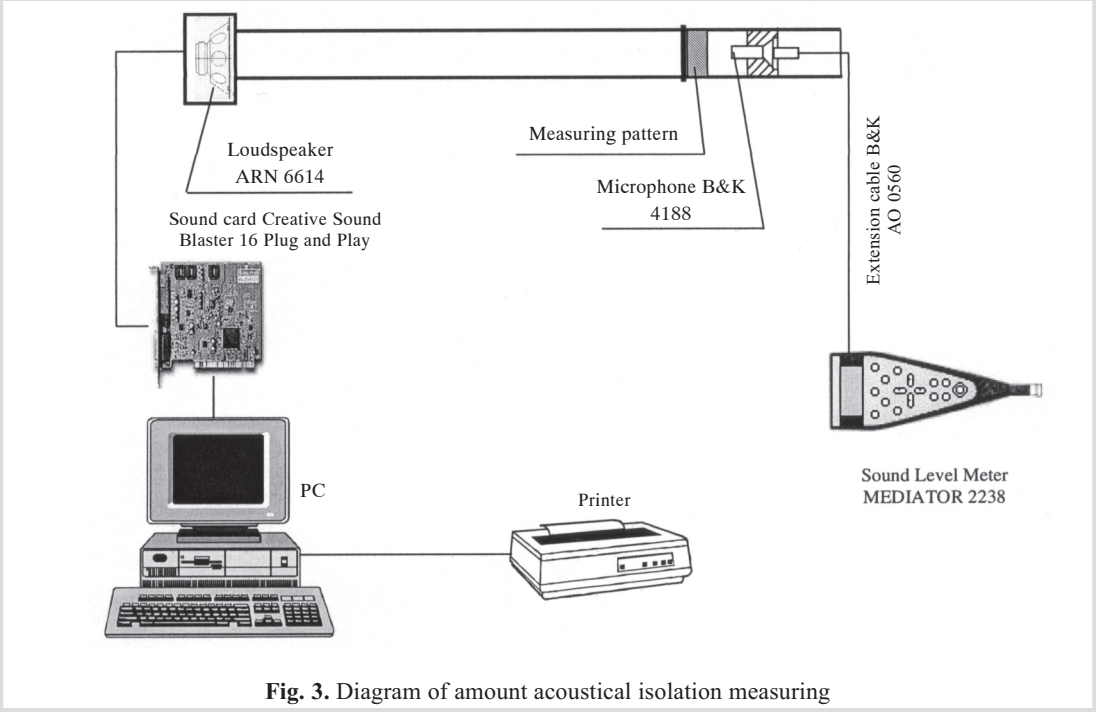

Fig. 3. Diagram of amount acoustical isolation measuring

Nowadays there are used devices, which employ methods of measuring acoustical absorption coefficient for normally incident waves by impedance tube or translation function. The advantage of such methods is accuracy reproducibility and small dimensions of patterns. Disadvantage is the necessity to use special loudspeakers with hole for lead holder, special devices for measuring and impossibility of measuring acoustical isolation by this same expensive apparatus.

The measurement of the noise absorption (α_n), noise reflection (R_o), noise transmitted (R_p) and noise isolation (D_{nf}) coefficients for normally incident sound requires a "standing wave". We are solving of this problem by method of impedance tube which enables measuring all required descriptors at once (see Figs. 2 and 3). The dependence all desired acoustical descriptors, which define acoustical materials, on frequency are determined mainly by configuration and spacing of pores, material thickness, thickness of air space behind the material and type of facing employed [11].

4. ACOUSTIC ANALYSIS OF RECYCLED MATERIALS

At our Department of environmental studies and process control of Technical University in Košice KEaRP we design the acoustical apparatus evaluated by realized prototype based on the impedance tube and standard featuring of a sound level meter (see Industry Design No 3679 from 9.10.2003 by Bureau of Slovakia Industrial Property).

Patterns were accorded by comprehension of firm VÚSAPL Nitra. Patterns consist of:

- double sided sandwich with thickness 65 mm and area weight 47.5 kg/m^2 (Fig. 4a),
- relieved rubber fraction with thickness 65 mm and area weight 47.1 kg/m^2 (Fig. 4b),
- rubber fraction with thickness 65 mm and area weight 59.7 kg/m^2 (Fig. 4c),
- abrasive of pneumatic with thickness 65 mm and area weight 57.8 kg/m^2 (Fig. 4d),
- shaped perforated tile VIPOELAST 1 PZI with area weight 35.7 kg/m^2 (Figs. 4e and 4f).

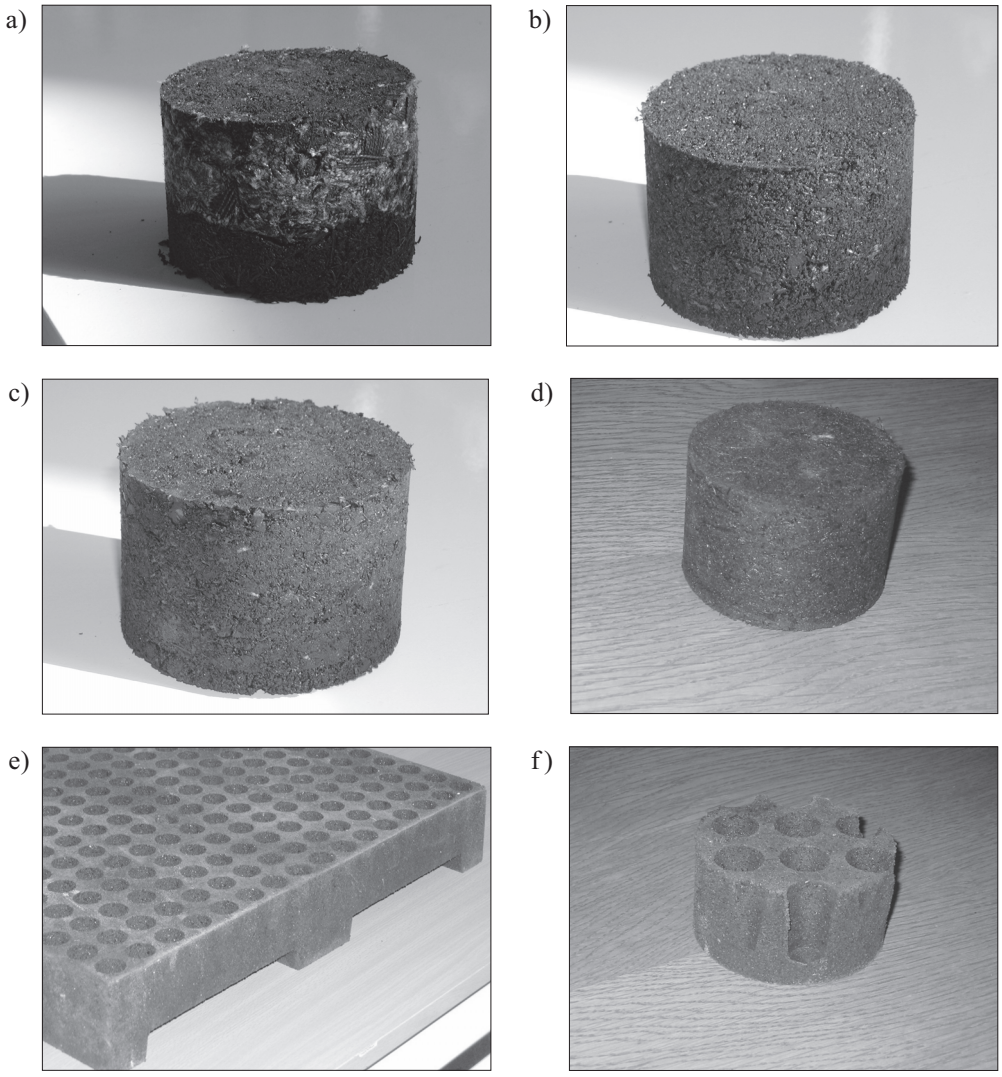

Fig. 4. Patterns from recycled pneumatic rubber
(a–f) see text

5. RESULTS OF MEASURING

Measuring results of acoustic patterns (Figs. 5–10) suggest on low value noise absorption coefficient at asked amount. Only one pattern made from rubber fraction with thickness 65 mm and area weight 59.7 kg/m^2 (Fig. 4c) is adequate for external wall part of occupied acoustic box because coefficients of noise isolation and reflection suggest on its essential property (material create pinnacle against unacceptable occupational noise). Internal wall part must be adorned combination of air space and material based on glass or basalt wool. This combination was experimental attested at graduated work [11].

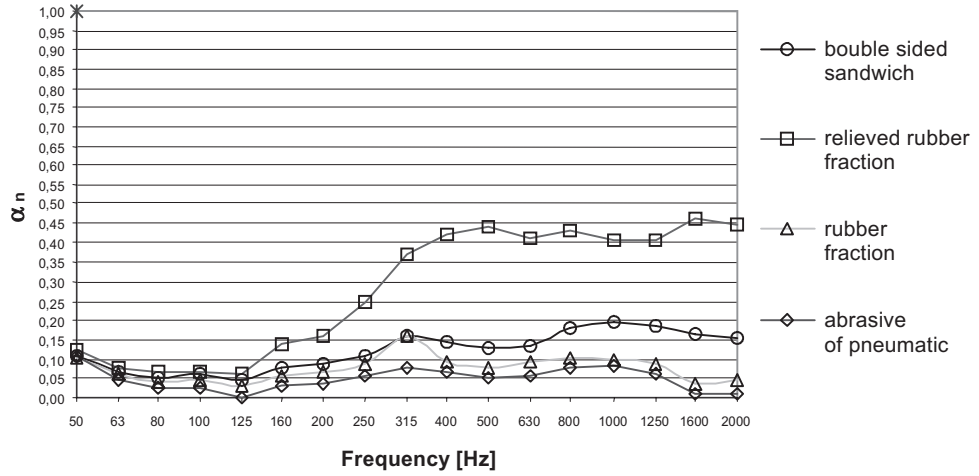

Fig. 5. Noise absorption coeffitient of investigated acoustic patterns

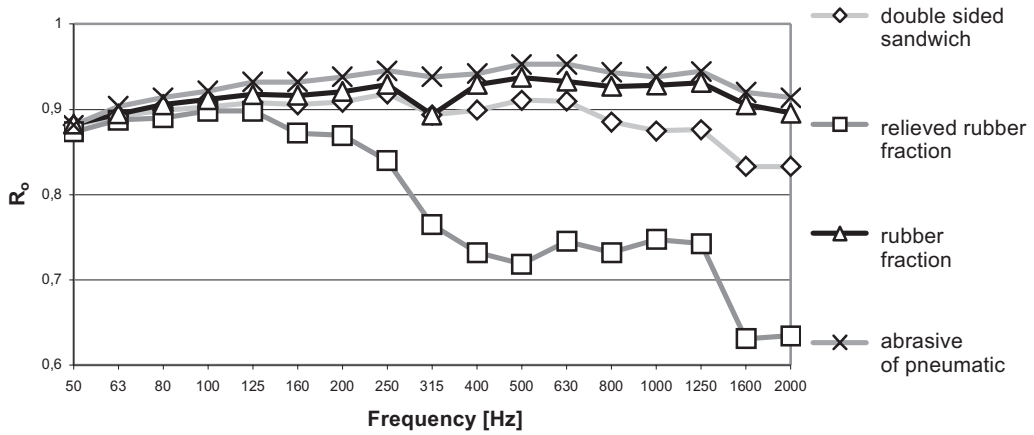

Fig. 6. Noise reflection coeffitient of investigated acoustic patterns

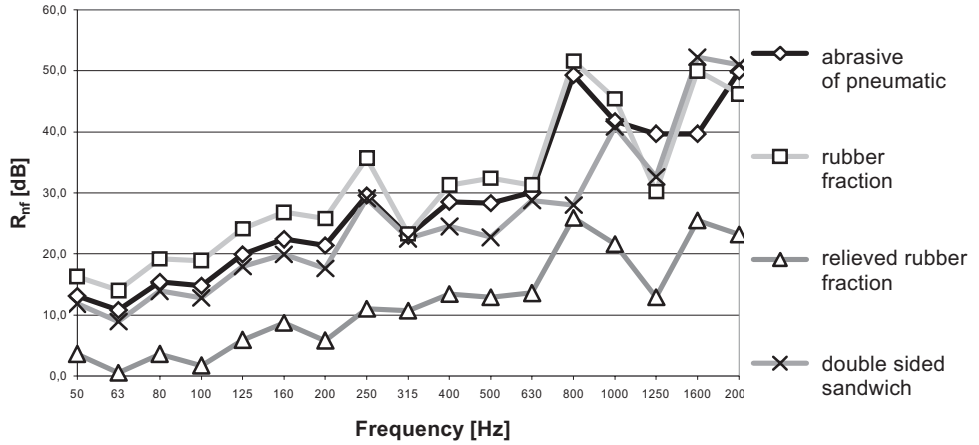

Fig. 7. Noise isolation coeffitient of investigated acoustic patterns

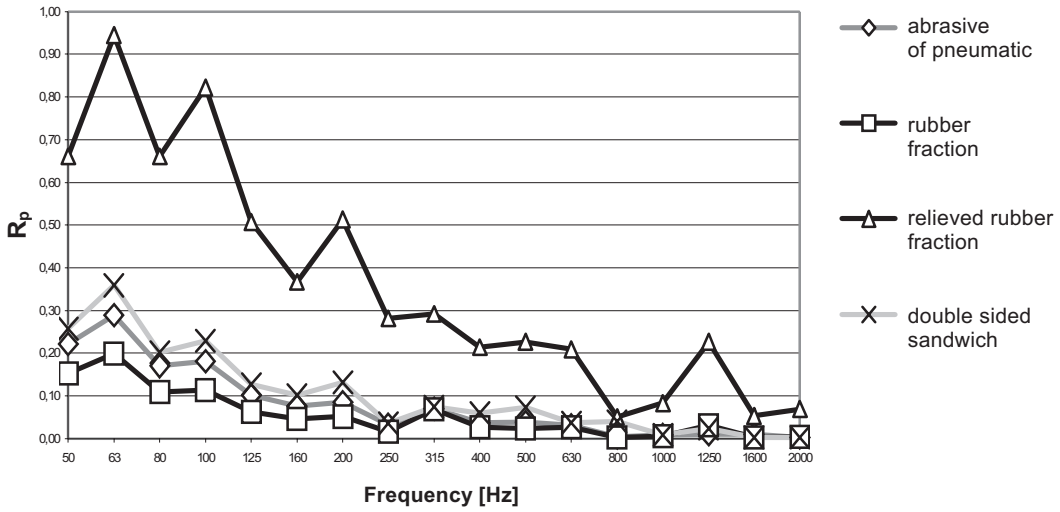

Fig. 8. Noise transmitted coeffitient of investigated acoustic patterns

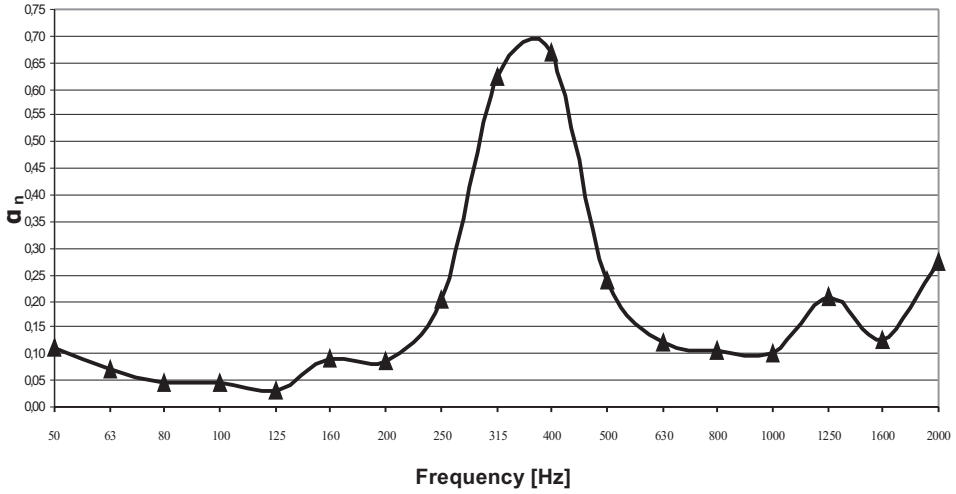

Fig. 9. Noise sorption coeffitient of shaped performed tile

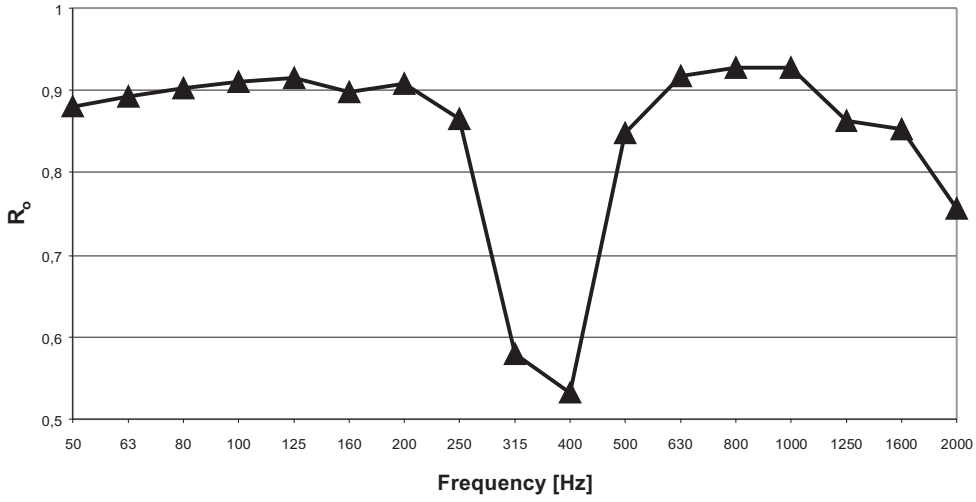

Fig. 10. Noise reflection coeffitient of shaped performed tile

6. CONCLUSION

On our Department of environmental studies and process control were done many experiments with acoustic patterns. We are developed method and realized inexpensive apparatus for measuring all acoustical descriptors which define acoustical materials at once. The used method enable realized stand for lower frequencies (under 50 Hz) also, but dimensions of solid patterns limit top band of measured frequencies into 3150 Hz.

Patterns of recycled porous materials made from recycled rubber do not approved assume of noise aborting on base Helmhotz resonator. It caused by used butadien-polyuretan binding material which keeps away connection of porous between itself.

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