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Analysis of SM 57 dynamic and SM 81 condenser instrument microphones for recording and sound reinforcement of Sarod: A comparative study

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Abstract

Recording / live sound reinforcement for different instruments require specific microphones. Therefore, the choice of use of particular microphone must be according to method of playing the instrument, timbre, application and the categorization of the instrument. Indian plectrum instrument- Sarod is a typical stringed plectrum instrument with the addition of percussion properties because of tightly placed goat skin on the belly. Also, Sarod is a very sensitive instrument and deals primarily in the low, low mid and mid frequencies in higher octave. Due to this nature of the instrument, the microphone must be carefully selected so that it sounds natural without coloration. This paper carefully investigates and compares recording of Sarod by using two industry standard microphones SM 57 dynamic instrument microphone and SM 81 condenser instrument microphone. The investigation is done on typical frequency response, Peak frequency response, comparative frequency responses in all the three octaves and technical specifications.

Keywords: Dynamic microphone, Condenser microphone, Frequency response, Sensitivity, Sarod

Research Paper

Introduction

In this investigation two industry standard microphones SM 57 dynamic instrument microphone and SM 81 condenser instrument microphones are carefully analysed.

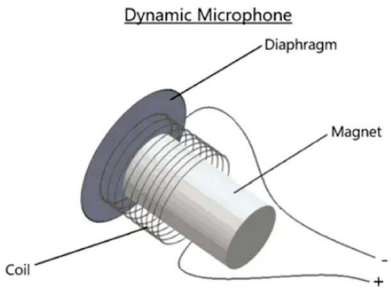

Figure 1: Dynamic Microphone

Source: https://audiouniversityonline.com

"Dynamic microphones are also called moving coil microphones. They function on the following principle: as a coil of wire moves in relation to a magnet, a voltage is created on the wire. In a dynamic microphone, the diaphragm is attached to a coil of wire. The coil of wire surrounds a magnet. The diaphragm is usually made of aluminium alloy or other low-mass material, so that it can be moved by the low-mass particles of the air. As the diaphragm shifts forward and backward with the movements in the atmosphere, the coil of wire also moves. Because the coil surrounds around a stationary magnet, as the coil moves around the magnet, a voltage is created on the wire." (Mathias)

"Condenser microphones are also called capacitor microphones. They function on the following principle:

If two metal plates are in close proximity, the closer they are, the higher the capacitance. Capacitance is the ability of a system to hold an electrical charge. In a condenser microphone, an electrically conductive diaphragm, usually made of gold-sputtered mylar, is suspended in close proximity to a solid metal plate. When sound waves interact with the diaphragm, it moves back and forth relative to the solid metal plate. This change in distance from the backplate to the diaphragm creates a change in capacitance, and an electrical signal is created. An impedance conversion circuit must be placed after the output of the capacitor to make the signal usable in an audio system. This circuitry requires +48V-DC, known

as phantom power. In some applications, such as cell phones and computers, electret condenser microphones are used which utilize permanently charged material and do not require phantom power."(Mathias)

"With their higher sensitivity, condenser microphones are more suitable for sources that need to be reproduced in great detail or are further away. In general, you can say that recordings created with a condenser microphone sound cleaner compared to dynamic microphone recordings. The most relevant difference between condenser and dynamic microphones is sensitivity. The difference in sensitivity largely determines the intended use of the two types of microphones." (Tobias et al.)

The qualitative comparative investigation of SM 57 and SM 81 has been earlier carried out on Acoustic Guitar by McKee (2023) with conclusion that both the microphones sound good for Acoustic Guitar and summarised sound for SM 57 as Bright and Warm and natural for SM 81 respectively.(McKee)

Objective: The objective of this research paper is to compare SM57 unidirectional dynamic instrument microphone and SM81 instrument condenser microphone by their frequency responses for recording/ live sound reinforcement for Sarod.

Hypothesis: The study would will reveal the different frequency responses of both the microphones and will thus fecilitate comparative analysis of Shure SM 57 and Shure SM 81 microphones. The performance of both SM 57 dynamic microphone and SM 81 condenser microphones for recsording Sarod can be analysed.

Research Method

Equipment used for the study–

1. Microphone Shure SM57
2. Microphone Shure SM81
3. Audio interface – Steinberg UR 22 MK II
4. Recording software-Cubase AI Elements 11

Table -1-Technical specifications*

Microphone	SM 57	SM 81
Type	Dynamic(Moving Coil)	Electret Condenser
Frequency response	40-15000 HZ	20-20,000 HZ
Polar Patern	Cardiod	Cardiod
Sensitivity	−56.0 dBV/Pa (1.6 mV) 1 Pascal=94 dB SPL	¬−45 dBV/Pa[1] (5.6 mV)

Source*: User Guides of Shure SM 57 and SM 81-Shure Publications

Both the microphones were placed at a distance of 08 inches from the sound source at an angle of 30 degree. The gain was set by clipping method. Alap on Sarod was played and recorded from both the microphones at same time. SM 81 has three position switch- flat, low frequency roll off at 300 Hz and drastic low frequency cut off at 100 Hz. This investigation was recorded in flat position. Gain was set at the clipping level of the microphone. Three position switch is not available in SM 57. The recording was not processed further to minimise error.

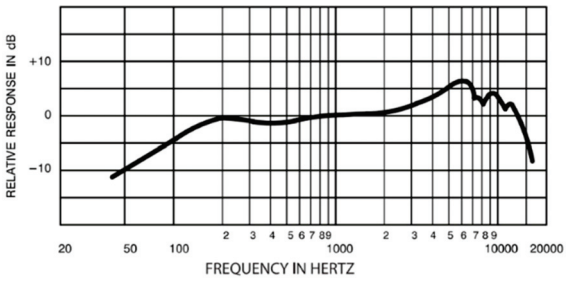

Figure 2. Typical frequency response of SM 57

Source–User Guide-SM 57-Shure Publications

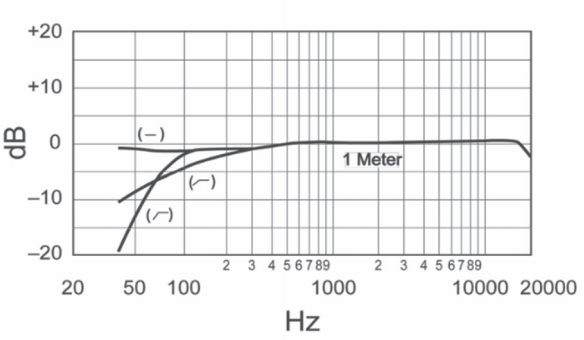

Figure 3. Typical frequency response of SM 81

Source–User Guide-SM 81-Shure Publications

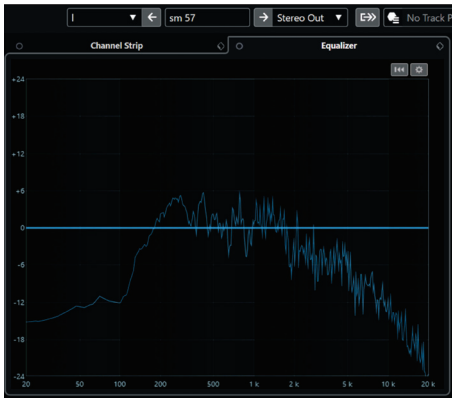

Figure 4. Actual peak frequency response of SM57

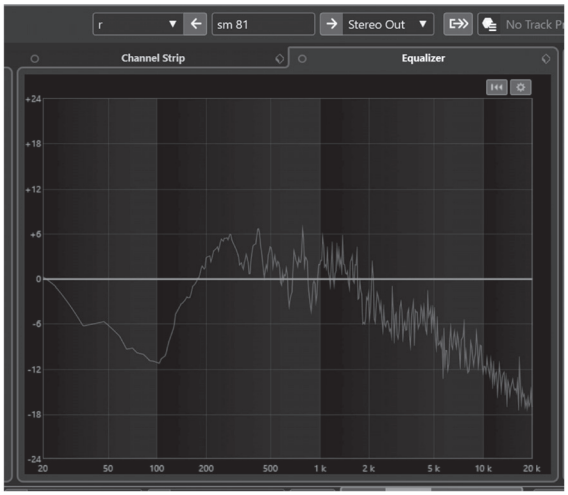

Figure 5. Actual peak frequency response of SM81

Figure 6. Comparative frequency response in Lower Octave

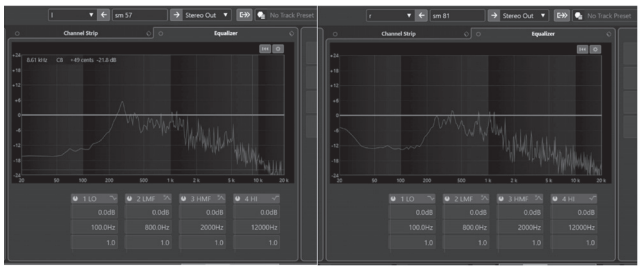

Figure 7. Comparative frequency response in Middle Octave

Figure 8. Comparative frequency response in Higher Octave

Peak frequency responses and comparative frequency response in three octaves of both the microphones are shown in figure 4,5 and 6,7,8 respectively using Cubase AI Elements11 recording software.

Conclusion and findings

When both the microphones are compared by their given parameters by their typical frequency response curve as per the company specifications, microphone SM57 shows drastic low frequency roll off below 200 Hz and shows boost at around 2000 Hz. Whereas SM 81 has three position switches for selecting low frequency response. In the normal position it shows flat frequency response. In the other two options of low frequency roll off around 300 Hz and low frequency cut off around 100 Hz.(Figure 2 & 3)

In actual recording, gain was set at clipping level which was 9.0 for SM 57 and 7 for SM 81, thus suggesting more sensitivity of SM 81. When compared actually, the peak frequency response of the microphones are recorded as shown in figure 4 and figure 5. As shown in the typical frequency response of SM 57, the bass response of the microphone is relatively weak as compared to SM 81 when recorded actually (figure-3) resulting in transient loses. The frequency response curve suggests much similar response in frequencies above 200 Hz. The frequency response of both the microphones are more or less similar in low mid-range. However as shown in the typical frequency response of SM 57 the high frequencies near 2000 Hz are boosted which results in coloration and brightness.SM 81 however has neutral response and thus sounds more natural. SM 81 is more sensitive and sounds very neutral as compared to SM 57 which shows prominent characteristics of frequency boost at high frequencies thus causing coloration and thus effecting the natural tone of the instrument. As per the table-1 SM 81 has greater sensitivity and has more range of frequency response. When compared through actual hearing of both the tracks, it is found that detail information in SM 57 is lost as it is a dynamic microphone having diaphragm attached to a coil. Higher Decibels were also achieved by SM 81 as compared to SM 57. (Figure 4 and 5).

On comparing both the microphones in lower, middle and higher octave, there is significant cut in low frequency below 100 Hz in SM 57. Whereas SM 81 shows boost at 50 Hz in all the octaves and significant boost in the lower frequencies can be seen (Figure 6,7,and 8). Thus having a detailed low end. The low frequency cutoff at 200 Hz in SM 57 misses the prominent details in this frequency range. Hence the sound in the lower end sounds dull. In contrast SM 81 delivers a livelier and robust performance due to flat frequency response.

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