

Indoor Air Quality

Monitoring the Presence of Airborne Particulate Matter in Residential Indoor Air Quality

Indoor air quality (IAQ) is an important aspect of well-being in our residential homes and workplaces. While living in a desert environment, it is common to experience frequent dust storms that lead to high particulate matter concentrations in the ambient air. As such, an exploratory survey was conducted by KAUST Health, Safety, and Environment (HSE) during September 2021 and January 2022 to assess the PM10 and PM2.5 concentrations of typical residential units in KAUST during normal weather conditions and during sand storm conditions. Although the study was limited in its scope in terms of the type of facilities involved and the time frame, it still provided valuable insights.

During IAQ assessments, IAQ parameters are selected based on the professional judgment of professionals typically trained in industrial hygiene. One of those parameters is measuring airborne particulate matter (PM), a complex mixture of solids and aerosols that varies in size, shape, and chemical composition. Particles are defined by their diameter for air quality purposes. According to the United States Environmental Protection Agency (US EPA), [numerous scientific studies have linked particle pollution exposure to various health problems](#). Specifically, particles with a diameter of 10 microns or less (PM10) are inhalable into the lungs and fine particulate matter, defined as particles that are 2.5 microns or less in diameter (PM2.5). PM10 and PM2.5 concentrations can reach high levels during sand storm episodes, especially in the proximity of the source areas but also in distant regions. Particulate matter is typically brought indoors from outdoor dust, pollen, smoke, smog and other outdoor sources. Indoor sources may include burning candles, incense, copier machines, paper dust, environmental tobacco smoke, skin cells, pet dander, and dust mite allergens.

Comparing indoor particle concentrations to outdoor concentration provides information regarding the effectiveness of filtration and the potential for indoor sources contributing to airborne particulate matter. Therefore, for the purposes of the survey, HSE obtained ambient airborne particulate concentrations for PM₁₀ and PM_{2.5} from the [KAUST Weather station](#), while indoor airborne particulate concentrations were obtained using a [Graywolf 3016 particle count instrument](#). The indoor particle count was monitored over a 24-hour cycle at four different occupied residential units in the Garden and Island neighborhoods. The surveyed houses included one-bedroom, two-bedroom, three-bedroom, and four-bedroom units. The results of the survey is summarized in Table 1.

Table 1: Indoor Air Quality Survey Results for Selected Particulate Matter

Date (weather condition)	Ambient Air Quality		Indoor Air Quality		Particulate Reduction	
	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	PM ₁₀ (µg/m ³)	PM _{2.5} (%)	PM ₁₀ (%)
Sep. 6 th 2021 (No sandstorm day)	17.08	24.06	3.27 (Survey Location # 1)	1.65 (Survey Location # 1)	80.85	93.14
Sep. 9 th , 2021 (No sandstorm day)	29.63	45.30	3.72 (Survey Location # 2)	1.39 (Survey Location # 2)	87.44	96.93
Sep. 13 th , 2021 (No sandstorm day)	14.77	21.75	15.43 (Survey Location # 3)	15.88 (Survey Location # 3)	+4.46% (Increased)*	26.98%
Sep. 18 th , 2021 (No sandstorm day)	14.31	22.36	4.83 (Survey Location # 4)	5.45 (Survey Location # 4)	66.24%	75.62
Jan. 22 nd , 2022 (Sandstorm day)	49.6	153.5	8.04 (Survey Location # 1)	15.88 (Survey Location # 1)	83.79%	89.6

* We believe this slight increase of PM_{2.5} is function of indoor activities that we could not ascertain at the time of the survey.

In conclusion, the airborne particle matter concentrations of monitored homes were within expected levels and acceptable concentrations considering industry guidelines for indoor air during typical weather and sandstorm conditions. While some IAQ problems may be transient and difficult to identify without extensive, long-term monitoring and testing, obvious or typical sources of IAQ issues that might detrimentally impact the occupants’ health was not detected.