Kajian keselamatan material bejana aqueous homogeneous reactor AHR dengan menggunakan ansys 15 dan verifikasinya secara eksperimen = Material safety assessment of aqueous homogeneous reactor AHR vessel by using ansys 15 and its experimental verification

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Abstrak

[ABSTRAK
Technetium 99m, yang dihasilkan melalui molybdenum-99, merupakan radioisotop terbanyak digunakan di dunia kedokteran nuklir. Untuk memproduksi molybdenum-99, sekarang ini sedang dikembangkan reaktor nuklir jenis aqueous homogeneous reactor (AHR). Meskipun penelitian terkait AHR telah banyak dilakukan, belum begitu banyak referensi yang membahas tentang aspek materialnya, padahal aspek material merupakan salah satu hal yang penting untuk diperhatikan dalam mendisain AHR. Dalam hal ini, salah satu hal yang perlu untuk diteliti adalah berhubungan dengan integritas struktural bejana AHR yang diakibatkan oleh stress akibat adanya tekanan serta suhu operasi reaktor. Desain dari bejana harus mampu menahan kondisi pengoperasian normal, kondisi kecelakaan atau abnormal yang mungkin, serta mempertimbangkan adanya cacat retak yang mungkin ada pada bejana. Penelitian ini dilakukan melalui simulasi komputer metode finite elemen (FEM) dengan bantuan software ANSYS sedangkan verifikasinya dilakukan secara eksperimental. Akan tetapi, karena kompleksnya permasalahan dalam sebuah reaktor, maka verifikasi hanya dilakukan dengan cara membandingkan hasil uji tarik pada kondisi AHR dengan simulasi uji tarik dengan ANSYS. Hasil uji tarik secara eksperimen dan uji tarik secara simulasi ANSYS menunjukan korelasi yang sangat baik sehingga diasumsikan bahwa simulasi yang dilakukan dapat mewakili kejadian yang sebenarnya. Hasil simulasi pada AHR menunjukan bahwa tekanan dan suhu pada bejana berpengaruh pada stress material bejana. Semakin tinggi tekanan dan suhu pada bejana maka akan semakin tinggi juga stress yang diterima oleh material bejana. Ukuran cacat retak yang disimulasikan pada bejana juga memberikan pengaruh pada nilai stress intensity factor (SIF) yang dihasilkan dimana semakin besar ukuran cacat retak, akan menghasilkan nilai SIF yang juga semakin tinggi. Penggunaan material reflektor juga memberikan pengaruh yang signifikan terhadap stress yang diterima oleh bejana reaktor. Hal ini disebabkan adanya tambahan stress yang berasal dari thermal stress antara material bejana dan juga material reflektor. Dari seluruh simulasi yang dilakukan, nilai equivalent (von-Mises) stress yang dihasilkan masih dibawah nilai yield strength dan fracture toughness (KIC) bejana AHR sehingga integritas bejana masih terjaga dan retak yang ada tidak mengalami propagasi menjadi suatu kegagalan.
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ABSTRACT
Technetium-99m, which is generated through a source of decaying molybdenum-99, is the the most commonly used medical radioisotope. To produce molybdenum-99, nuclear reactor types of homogeneous aqueous reactor (AHR) are being developed by many investigators. Although AHRs-related research have been done, yet many references that discuss the aspects of the material are rarely available. At the same time, material is one of important aspects to consider in designing AHR. In this case, one thing that needs to be investigated in relation to the structural integrity of AHR vessels is the stress caused by the pressure and

temperature of the reactor operation. The design of vessels needs to consider many aspects such as normal operating conditions, possibility of accident or abnormal conditions, as well as consideration of the existence of defects that may exist in the vessel. This research was peformed through a computer simulation by using finite element method (FEM) available in ANSYS. The validity of the simulation was then verified experimentally. However, due to the complication of the reactor, verification was just conducted by comparing the experimental results of tensile test at AHR contiditon with the tensile test simulated by using ANSYS. The results of the experimental tensile test and the tensile test simulated by using ANSYS showed an excellent correlation. In this case, the results of the simulation was assumed to represent the actual event. The simulation results on AHR show that pressure and temperature in the vessel affect the stress of the vessel material. The higher the pressure and temperature in the vessel, the higher the stress of the vessel material. The size of the simulated crack defects in the vessels also affects the value of stress intensity factor (SIF); the greater the crack the higher the SIF value. The use of reflector material also has a significant influence on the stress experienced by the vessel reactor. This is due to the additional stress from thermal stress between the vessel and reflector materials. However the equivalent (von-Mises) stressess obtained from all of the simulation are still below the yield strength and fracture toughness (KIC) of the AHR vessel so that the integrity of the vessel is maintained and that any existing cracks would not propagate to becomea a failure.;Technetium-99m, which is generated through a source of decaying molybdenum-99, is the the most commonly used medical radioisotope. To produce molybdenum-99, nuclear reactor types of homogeneous aqueous reactor (AHR) are being developed by many investigators. Although AHRs-related research have been done, yet many references that discuss the aspects of the material are rarely available. At the same time, material is one of important aspects to consider in designing AHR. In this case, one thing that needs to be investigated in relation to the structural integrity of AHR vessels is the stress caused by the pressure and temperature of the reactor operation. The design of vessels needs to consider many aspects such as normal operating conditions, possibility of accident or abnormal conditions, as well as consideration of the existence of defects that may exist in the vessel. This research was peformed through a computer simulation by using finite element method (FEM) available in ANSYS. The validity of the simulation was then verified experimentally. However, due to the complication of the reactor, verification was just conducted by comparing the experimental results of tensile test at AHR contiditon with the tensile test simulated by using ANSYS. The results of the experimental tensile test and the tensile test simulated by using ANSYS showed an excellent correlation. In this case, the results of the simulation was assumed to represent the actual event. The simulation results on AHR show that pressure and temperature in the vessel affect the stress of the vessel material. The higher the pressure and temperature in the vessel, the higher the stress of the vessel material. The size of the simulated crack defects in the vessels also affects the value of stress intensity factor (SIF); the greater the crack the higher the SIF value. The use of reflector material also has a significant influence on the stress experienced by the vessel reactor. This is due to the additional stress from thermal stress between the vessel and reflector materials. However the equivalent (von-Mises) stressess obtained from all of the simulation are still below the yield strength and fracture toughness (KIC) of the AHR vessel so that the integrity of the vessel is maintained and that any existing cracks would not propagate to becomea a failure., Technetium-99m, which is generated through a source of decaying molybdenum-99, is the the most commonly used medical radioisotope. To produce molybdenum-99, nuclear reactor types of homogeneous aqueous reactor (AHR) are being developed by many investigators. Although AHRs-related research have been done, yet many references that discuss the aspects of the material are

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